AIR CONDITIONING HEATING AND VENTILATING

NOVEMBER 1961

For the Engineer
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APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT
for
AIR CONDITIONING
HEATING • VENTILATING
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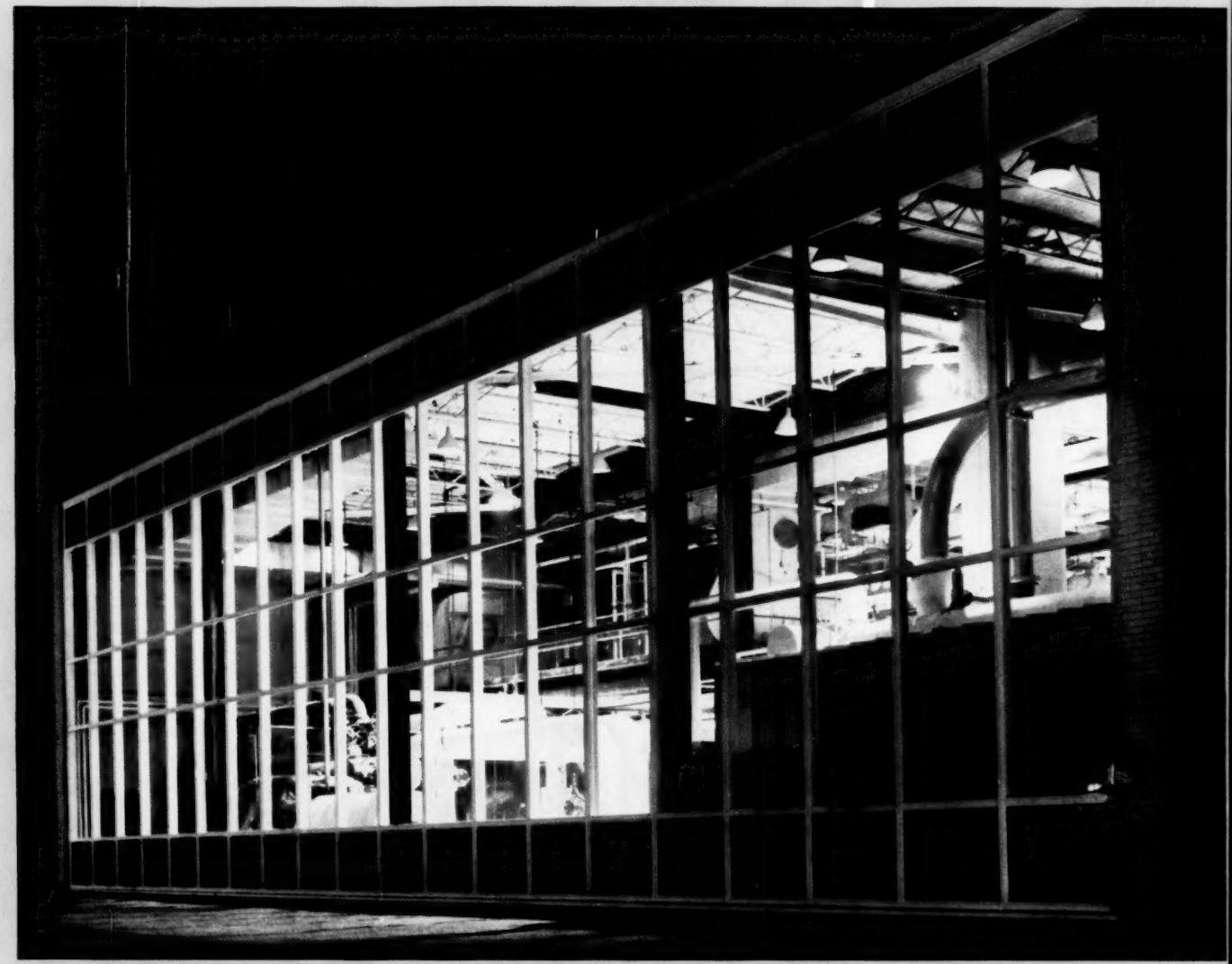

Boiler House, Koppers Research Center, Somervell Park, Monroeville, Pa. See page 4.

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Another New Hospital to Meet the Critical Needs

Architects: SHUTZE, ARMISTEAD & SAGGUS AND ASSOCIATES–WILLIAMSON, VAUGHT AND SPIKER; *Engineers:* NEWCOMB & BOYD; *Mechanical Engineering Contractor.* GILLOOLY AND STEPHENSON; *General Contractor* BEERS CONSTRUCTION COMPANY, Atlanta, Ga.

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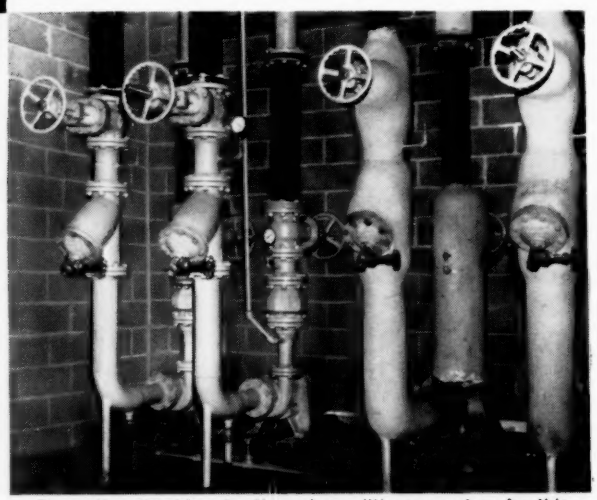

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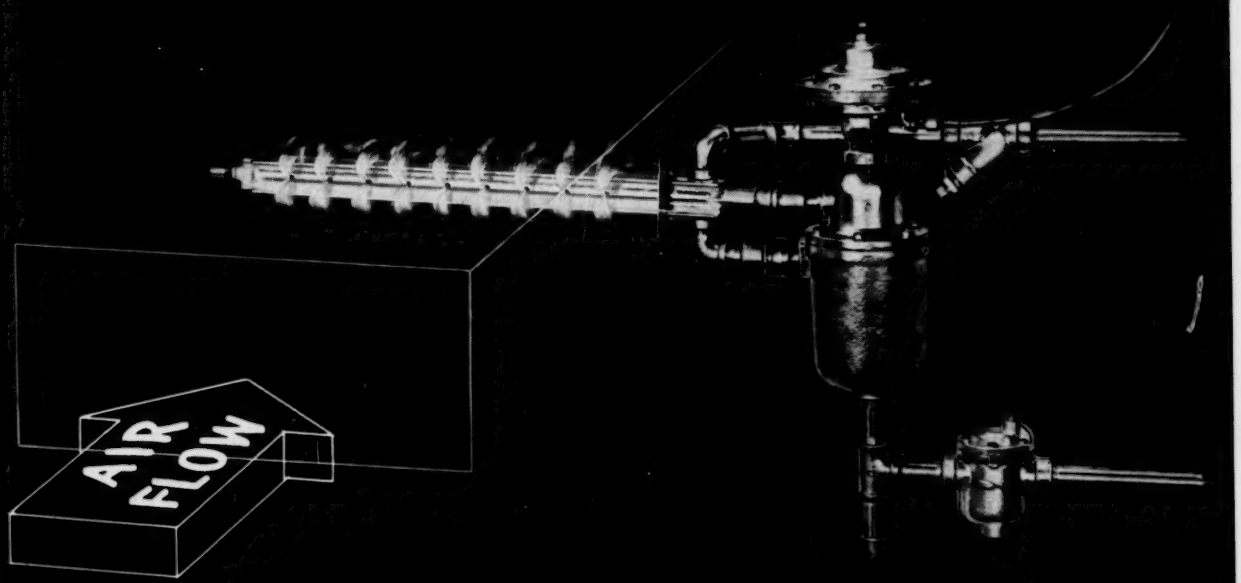
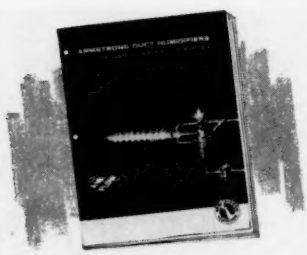


ARMSTRONG DUCT HUMIDIFIERS

with steam jacketed distribution manifold



Bulletin 504 gives complete data on Armstrong Duct Humidifiers . . . how they work . . . how they avoid duct condensation . . . dimensions . . . capacities . . . sizing information . . . and how they can be installed. . . . Ask for a copy.

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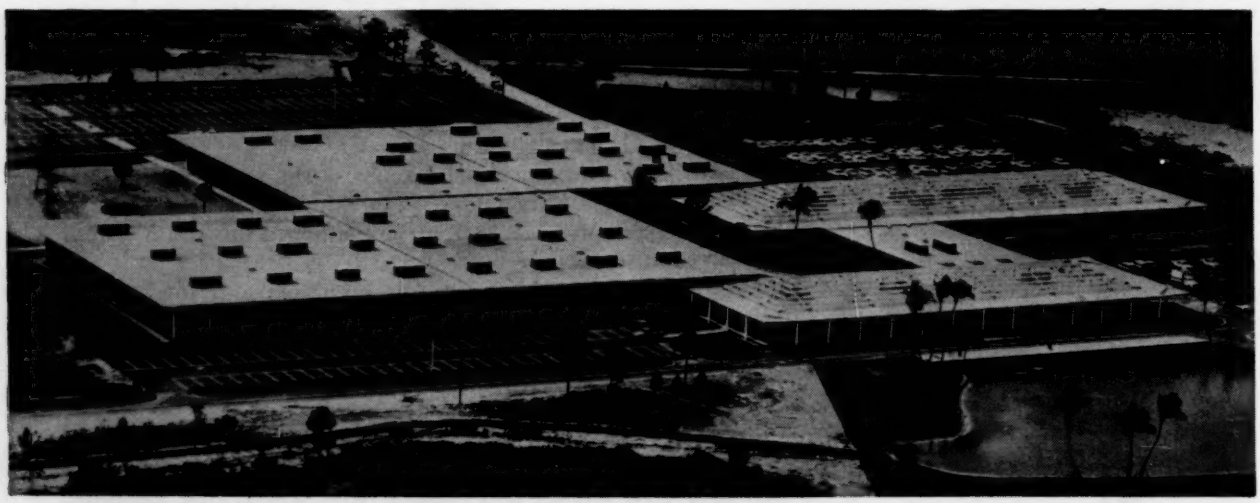

Architect: Malcolm B. Wells, Merchantville, N. J. • Assoc. Consulting Engineer: Arthur Parker Assoc.

In right foreground, the Administration Building, RCA plant, Palm Beach Gardens, Fla., with three Atmos-Pak units under simulated hip roof. Immediately behind, the Restaurant, two units. Behind that the Engineering Building, simulated hip roof, ten units. In the rear, Warehouse. 19 units, and left, Manufacturing, 24 units. Total capacity 1000 tons.

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COVER PHOTO: **A glass-walled boiler house** is only one of the interesting features of the new Koppers Research Center, located at Somervell Park, Monroeville, Pa. Another is the glass-enclosed steel stairway at the end of each laboratory "wing" which can be readily removed by a large crane, permitting extension of a wing to any desired length. Physically and aesthetically designed by Voorhees, Walker, Smith, Smith and Haines to provide the optimum environment for scientific effort, the research center houses modular laboratories, each boasting air conditioning, fume control, safety equipment and separate service trenches.

HIGH SPOTS in this issue

JAROS ON OFFICE BUILDINGS: How the building facade affects the choice of air conditioning system, and the proper posture of the mechanical engineer toward owner and architect are but two of the many facets of the paper by Alfred L. Jaros, Jr., delivered last month in London at the International Conference on Heating, Ventilating and Air Conditioning (HEVAC) and reproduced this month in the **Reference Section,** starting on page 79.

Owen S. Lieberg, ACHV author of **High Temperature Water Systems,** covered the entire HEVAC Conference and Exhibition. His report appears this month on pages 8 and 10.

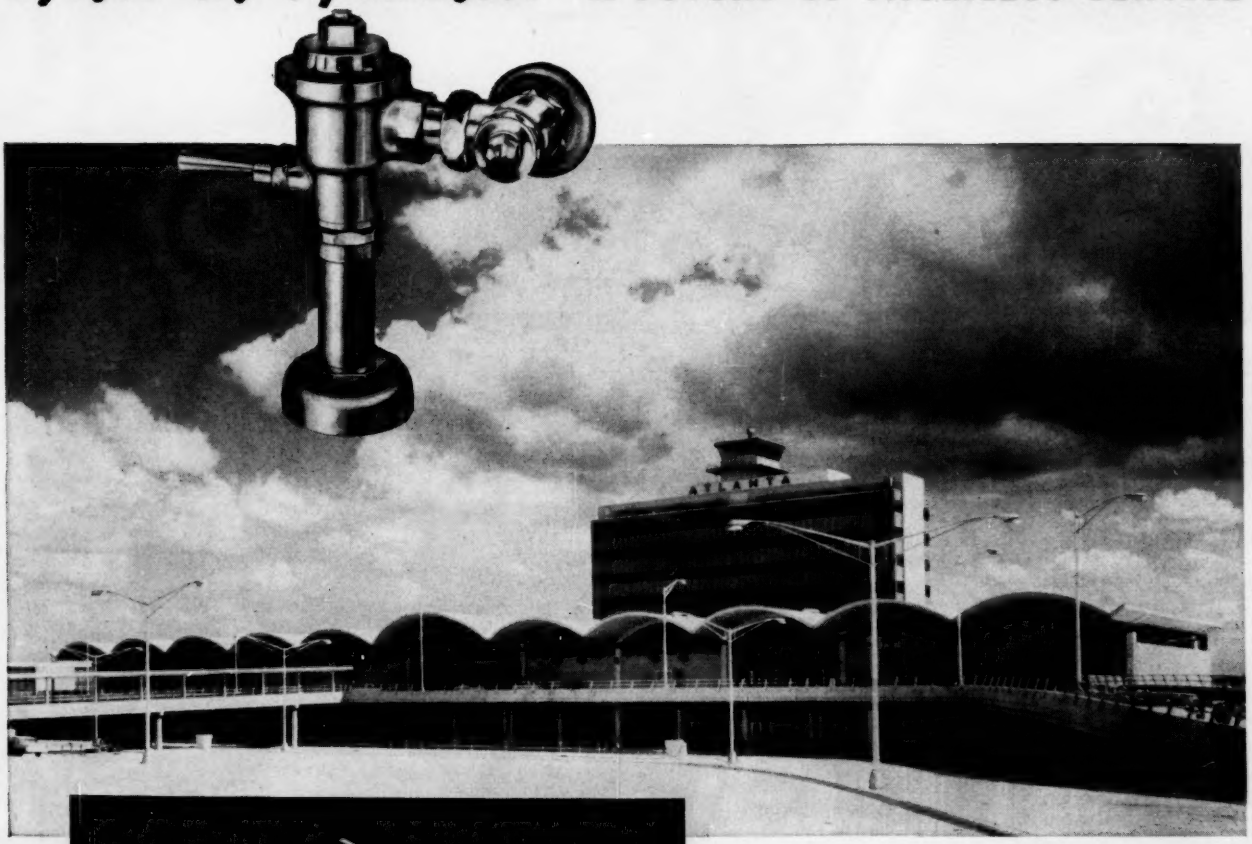
AIR RECOVERY: Teaming a device which can clean air with a device which can purify it, to reduce the requirement for outside air, results in what is called an "air recovery system". The **potential savings offered by such a system are great,** and the calculation of them is not only simple but enlightening. See H. L. Barnebey's article on page 59.

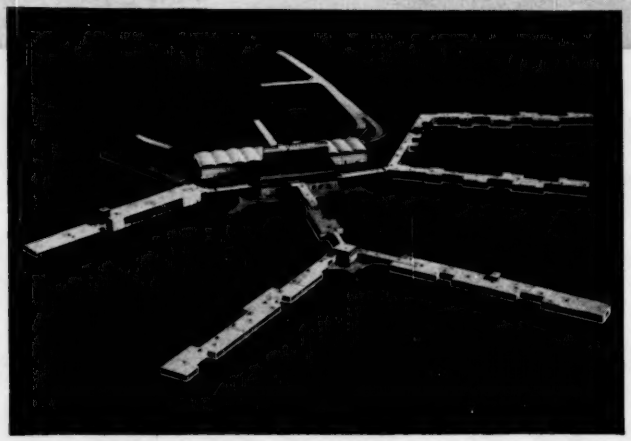
MORE LIGHT ON U-VALUES: Professor Komkov's article this month does three things: It provides a deeper understanding of the **U-value method of estimating heat transfer;** It carries forward from his last article the discussion on where the U-value method breaks down; and explains, for the intellectually curious, how heat flow through a non-uniform wall can be studied by analogy to an electrical circuit. See page 70.

CONTROLLING ELECTRIC HEAT: In the home, electric heat control only has to meet a simple on-off standard. In **commercial applications, however, a more complex control standard is required** to satisfactorily regulate intricate systems of radiation, ventilation and air conditioning. And with that opening, Frank Watson, Canadian controls engineer, is off and running in a good, recommendation-loaded article beginning on page 74.

QUICK METHOD FOR AIR QUANTITIES: By using the new slide-rule procedure outlined in Douglas May's article, **outlet air quantities can be rapidly calculated** to account for heat gain or loss in the supply ducts. See page 63.

And in Atlanta—A FUTURE OF FAULTLESS SERVICE





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Report from London

HEVAC was a tremendous success.....

by Owen S. Lieberg, Consulting Engineer

IF NUMBERS OF REGISTERING DELEGATES is an indication, The International Conference on Heating, Ventilating and Air Conditioning (HEVAC) with its associated International Exhibition (the first ever to be held in Europe) was a tremendous success. Out of over 900 registrants, at least 350 came from 24 countries other than Great Britain, while thousands more visited the Exhibition.

Among the delegates from the United States who delivered papers at the Conference were Alfred L. Jaros., Jr., of Jaros, Baum & Bolles, whose talk on the economics of office building air conditioning is the subject of this month's Reference Section*; Ed Pita, Guy B. Panero, consulting engineers, who discussed the design for the new University of Baghdad; and Professors Burgess H. Jennings and T. C. Min, who spoke on "Air Conditioning Trends during the Coming Decade" and "Controlling Infiltration through Entrances in Tall Buildings," respectively. John Everetts, Jr., ASHRAE president, represented the United States and was given a sincere and friendly greeting by the President and Council of the British Institution of Heating and Ventilating Engineers, sponsor of the Conference.

In his message to the Conference, Prince Philip, Duke of Edinburgh and patron of the Conference, extolled the benefits to mankind of the work of heating and ventilating engineers. "I hope," he said, that "discussions at the Conference will serve to stimulate new ideas and activity in this field which can do so much for our health, well being and comfort."

In all, 27 papers were read by authors of international reputation with technical contributions from a large number of delegates. The discussions greatly added to the value of the Conference, particularly as they represented the views of delegates from countries some thousands of miles apart, and countries with divergent weather conditions, customs and constructional problems.

Probing the Next Decade

Theme 1, *Administrative Advances in the Next Ten Years*, comprised seven papers on subjects of great importance to those connected with the industry:

Dr. D. R. Scott (Great Britain), head of National College, outlined the problems faced by smaller industries and the solution through the medium of National Colleges and the training of operatives, draftsmen and engineers. W. R. Spencer (Great Britain) covered the "Management" aspect of a manager's job. Erik Gabrielsson (Sweden), in a paper on contract planning and organization of site operations, told how a heating and plumbing contractor with five hundred workers developed a method of prefabrication of the whole installation.

Sir Harold Roxbee Cox (Great Britain), chairman of the Council for Scientific and Industrial Research, spoke on the financing of research and development. F. A. Pullinger (Great Britain) emphasized the interdependence of builder and heating engineer and the relationship of designer and contract engineer. Dr. B. K. Blount (Great Britain) laid special emphasis on how collective university and private research can be extended internationally.

M. J. Gartside (Great Britain), Chairman of the Heating and Ventilating Research Association, gave an account of the work of his organization.

Theme 2, *Technical Advances in the Next Ten Years*, with thirteen papers was more international in its viewpoint.

Professor Jennings discussed the future of the air conditioning industry in America. He developed with originality the application of air conditioning systems to the varied climatic conditions, ranging from sub-tropical to the cooler zones, of industrial and commercial buildings in the United States of America.

Professor Min presented design charts for heating and air conditioning loads through swinging and revolving doors and doorways and outlined the engineering conception of controlling infiltration.

N. S. Billington (Great Britain), director of the Heating and Ventilating Research Association, examined technological developments including the future use of solar and electrical energy for heating and the importance of automatic controls, intermittent heating and techniques of calculation with computers.

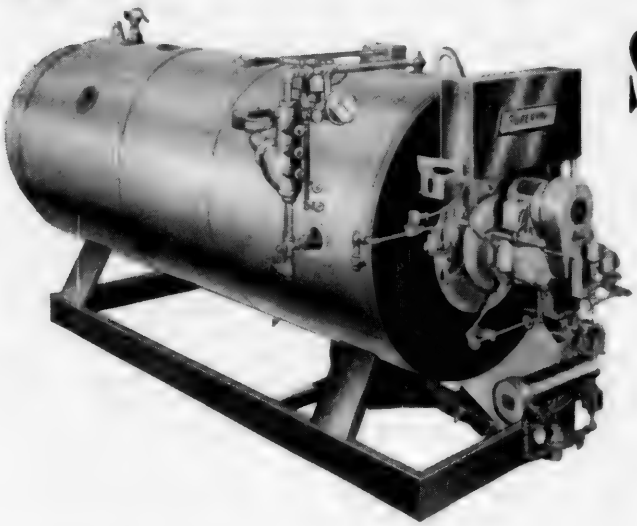
R. Cadiergues (France), covered grouping of heat production units for space and process applications with control of conditions; insulation efficiency and storage; and how new conditions affect different types of heat and power sources.

I. Livchak (U.S.S.R.) spoke of the enormous growth of buildings in his country necessitating prefabrication off-site to ensure rapid installation with least labor costs. He referred to the wide use of high temperature water for district heating schemes and gave details of air heating systems for commercial buildings. S. A. Gregory and D. Hackett (Great Britain) discussed "special duty" air treatment for factories requiring

(Continued on page 10)

* Page 79.

Consulting Engineers...



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And last, but not least, Consulting Engineers appreciate the importance of unit responsibility . . . that Superior Packaged Boilers are shipped *complete,* after factory fire testing, and are backed by the undivided responsibility of their maker.

Superior Packaged Boilers are engineered and produced by a manufacturer who is dedicated to packaged boilers *exclusively*...a firm which is as proud of its product's reputation for performance as is the Consulting Engineer of his professional standing.

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HEVAC was a tremendous success.....

(Continued from page 8)

low concentrations of dust or bacteria and low relative humidities. J. A. Naterop (Italy) described recent developments in his country to make use of higher water temperatures for multi-story buildings and the use of "open" single pipe heating systems.

J. M. Musgrove and J. Weeks (Great Britain) devoted their paper to hospital design. Professor Dr.-Ing. Fritz Roedler (Germany) emphasized the demands of hygiene in heating and ventilating of hospitals and clinics. He gave tables of statistics on air temperatures and humidities required for wards and his recommendations on air conditioning and dust extraction.

Dipl. Ing. W. Krueger (Germany) spoke on heating and cooling by radiant ceiling panels, which, in spite of higher installation costs, are becoming more prevalent in German hospitals because of their hygienic advantages. M. Piot (France) analyzed new French regulations to cover ventilation and air conditioning in operating theatres having due regard to the risk of explosion of the anaesthetics used, and the comfort of the patient, surgeon and his assistants. The paper dealt with the chemical and physical aspects of methods used to obtain pure and sterile air.

Tamas Forster (Hungary) gave design problems with typical data relating to operating theatres in his country. G. Werner (Denmark) presented a paper on "Air-Cooled Ceilings for Heat Absorption," giving new developments in the use of ceilings in air conditioning Danish hospitals.

Jaros, Pita Lead off Session

Theme 3, *Integrated Design of Architectural and Engineering Services,* began with Mr. Jaros' paper, "Economic Design of Services for Office Buildings." He was followed by E. G. Pita of Guy B. Panero who discussed the "Integrated Architectural and Engineering Design for the New University of Baghdad." He gave a lucid and explanatory description of the project with site location, buildings, and organization required for design of the architectural, civil, mechanical and electrical engineering work involved. He also illustrated central heating and refrigeration plant, and an integrated design approach to an individual building.

Further papers were given on a variety of subjects: Professor A. DeGrave (Belgium), president of the Belgian Council for Heating, Ventilating and Air Conditioning, dwelled on the relation of architecture to engineering in structure, the influence of climate and insulation. G. R. Winch (Great Britain) spoke on the comparison between the theoretical and actual operation of heating and air conditioning installations and operational factors affecting performance of automatic controls; performance of systems in industrial, commercial and public buildings; fuel burning appliances and effect of service conditions on performance and life of boiler plant.

IR W. Van Der Welden (Holland) based his paper on the integration of architectural and mechanical design of industrial buildings. He recommended a coordinated team of specialists of equivalent status to give unity and the fullest scope to both architect and engineer.

Professor J. Kozierski (Poland) examined techniques to suit Polish climatic conditions and countries with a mean average temperature below 12 deg F. The paper compared insulation and heating costs and the legal regulations used to control the heating of buildings in the interests of the residents. A. J. Gordon (Great Britain) recommended joint training of architectural, structural, mechanical and electrical engineers with heating and ventilating students in their student days. Professor J. K. Page (Great Britain) in the final paper of the conference studied the scientific approach to integration of design. He referred to the complex scientific problems encountered in heating, ventilating and air conditioning design and practice.

Interpreters Aid Visitors

Also at Olympia and as an adjunct of the Conference, HEVAC organized the first International Heating, Ventilating and Air Conditioning Exhibition ever to be held in Europe. It was open from September 26th to October 6th with interpreters in attendance to asist registered delegates from non-English speaking countries to inspect exhibits. Over 220 exhibitors participated to provide a comprehensive display of heating, ventilating and air conditioning equipment, including industrial air handling and treatment, dust and fume collection, valves, automatic controls and instrumentation, refrigerating units, pumps, heaters and allied plant of British, U.S.A. and European design and manufacture.

To add to the interest of the Conference, many technical visits were arranged for the delegates during the seven days that the Conference lasted.

Evening receptions and dinners enabled American and European delegates and their wives to meet their British counterparts. In addition to the Annual Banquet and Dance of the British Institution of Heating and Ventilation Engineers, dinners were held in the House of Commons and an informal reception at County Hall by the London County Council. Concerts and theatre parties were arranged and nothing omitted to ensure pleasant memories of the Conference by all those attending.

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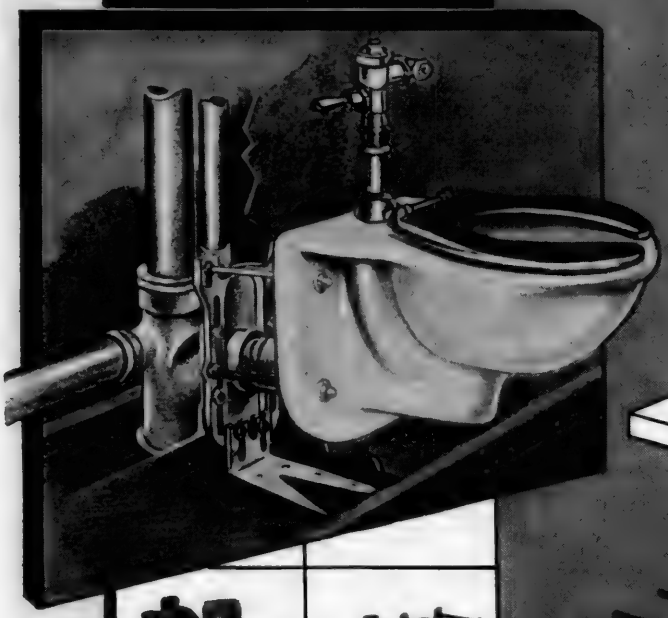

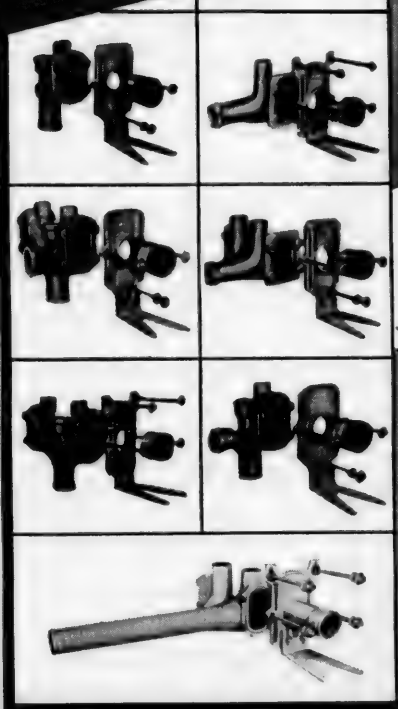

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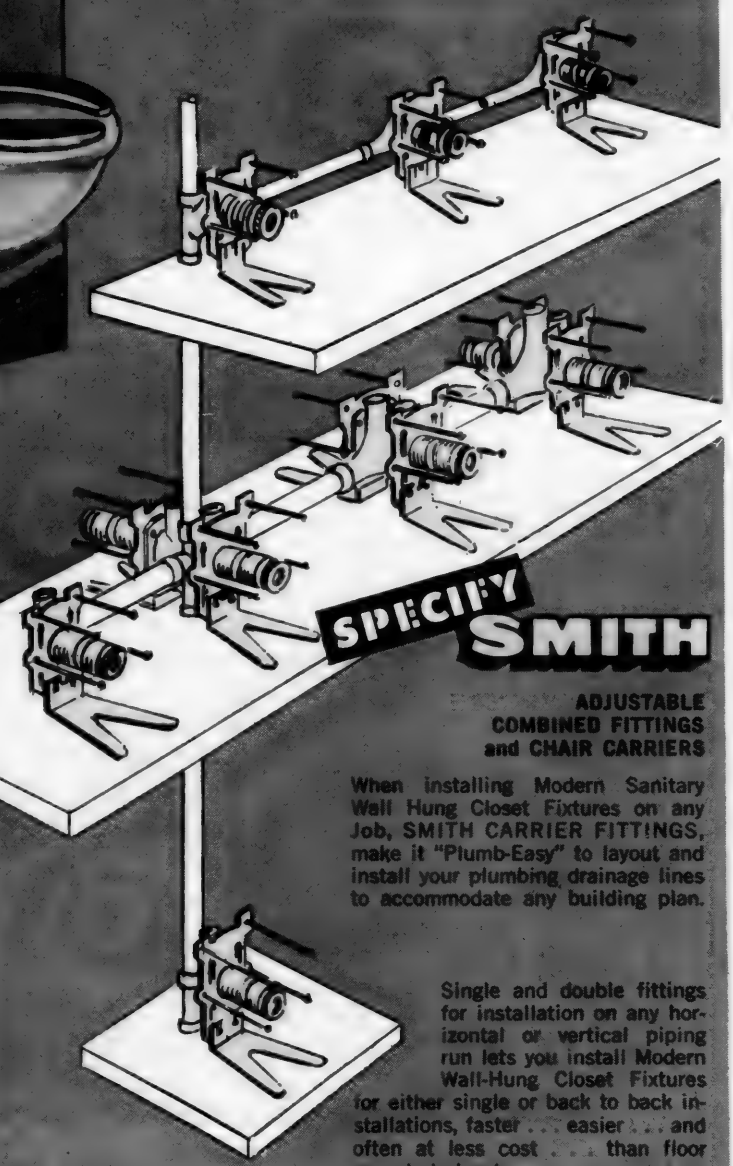

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PLUMB-EASY

NEWS OF THE MONTH

CONTRACTORS COOPERATING IN WATER HEATER LEASING PROGRAM

Bridgeport, Conn. plumbing contractors are said to be cooperating with the Bridgeport Gas Company in the utility's Ruud Mfg. Co. commercial gas water heater leasing program. A meeting with the gas company and a Ruud representative drew 150 plumbing contractors.

In the program, the customer pays the gas bill and a leasing fee which ranges from $9 to $17 a month. The utility is responsible for correct sizing of the equipment and its maintenance. Installation is made by the plumbing contractor who receives a $100 flat fee whether he originates the lease or not.

Speaking as a representative Bridgeport plumbing contractor, Bernard Palumbo, president of the Foster Plumbing Company, said that the program should give quick impetus to the growth of commercial gas water heating, and with substantial contractor profit.

THERMOELECTRIC PRODUCTION LINE — Two years ago, thermoelectricity — the direct conversion of heat into electricity — was little more than a laboratory curiosity. Today, this small-scale production line at the Westinghouse new products laboratories demonstrates the rapid transition of this new method of power generation from the laboratory to practical reality. On this line, final assembly and tests were performed on several thousand thermoelectric couples which comprise the largest thermoelectric generator ever built. The couples fit into interchangeable trays, or modules, which line the inside walls of the 5000-watt power plant. The generator, developed by Westinghouse for the Bureau of Ships, U. S. Navy, is an experimental unit intended for the evaluation of power-generating thermoelectric materials and fabrication techniques.

COAL ASSOCIATION DEBUNKS BOGUS CHEMICAL ADDITIVES

A warning against bogus chemical additives for coal firing that claim to solve a multitude of combustion problems is contained in the August-September issue of *Coal Marketing News*, published by National Coal Association, Washington, D.C. The latest of these chemical additives is said by its sponsors to bear a kinship to a space-age rocket propellant.

"Great discoveries" of these products run in cycles, about every five years, the *News* states. They generally claim to be able to change the properties of the ash content of coal. For example, they claim, if you have a coal that clinkers, the use of the additive will keep it from clinkering; or vice-versa, if the ash from coal won't clinker, they claim the additive will correct this condition by making it clinker. This is only one example. Some of the other problems that additives claim to correct or eliminate have to do with smoke, soot, fly ash on tubes, corrosion, refractory erosion, sulphur elimination, and greater boiler efficiency. It is an engineering fact that if a boiler problem is corrected, the boiler efficiency is bound to be improved.

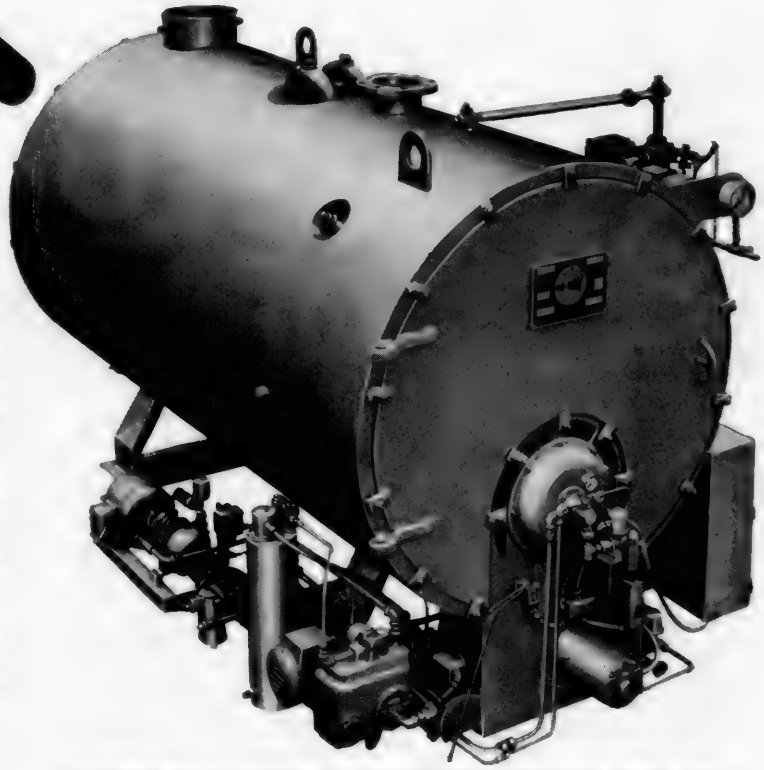
Samples Withheld

On several occasions, National Coal Association has asked for small samples of the "wonder" chemicals for the prime purpose of trying to find out what the stuff is, and how it could or would react in the laboratory. On all occasions, requests have been turned down with the explanation the producer would sell only in bulk or drum lots for boiler-furnace application, and stressing the fact that initial application and supervision would be under close scrutiny of the producer's personnel

(Continued on page 14)

REDUCE INSTALLATION COSTS

SPECIFY RAY BOILERS



LEADERS IN THE FIELD OF COMBUSTION EQUIPMENT SINCE 1872

ENGINEERED FOR MAXIMUM EFFICIENCY

The major expense in boiler installation and maintenance is the cost of labor, and that's where a Ray Packaged Boiler saves you money. The Ray unit you order arrives piped, wired and ready to use. Only a few simple service connections are required before you fire it up.

After installation, Ray labor saving features continue to mount up. Swing-away burner mounting and perimeter lug fastened hinged doors provide quick, free access to tubes and firing surfaces. The seamless tubes are rolled and beaded to the tubesheets, rather than welded, and may be removed quickly for replacement. And speaking of tube cleaning, Ray Packaged Boilers maintain maximum efficiency without the use of spinners or turbulators, so you won't find these usual hindrances to easy cleaning in a Ray Boiler.

Ray Packaged Boilers are designed for fully automatic, self-monitored operation on gas or oil. Soundly engineered, of outstanding quality, and competitively priced, these units are serviced by one of the most complete dealer organizations in the world. You'll find your local Ray Dealer in the Yellow Pages of the 'phone book.

From the world's first horizontal rotary oil burner, introduced by Ray, to the latest in packaged boiler systems, Ray's 89 years of experience guarantees you the most reliable products available in the field of combustion equipment.

CHOSEN FOR DEPENDABLE, LOW NOISE OPERATION

One 50 HP and two 80 HP Ray Packaged Boilers provide low cost, low maintenance heating for the Abraham and Strauss Department Store in the Walt Whitman Shopping Center at Huntington, Long Island, New York. In addition to the economy factors, low operating noise level was a major consideration in choosing Ray Packaged Boilers.

THE BOILER WITH AN INTERNATIONAL REPUTATION

RAY BURNER CO.
BOILER DIVISION
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SAN FRANCISCO, CALIFORNIA
4024 FILBERT STREET
PHILADELPHIA 4, PENNSYLVANIA

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DEBUNK COAL ADDITIVES

(Continued from page 12)

until full payment was made by the purchaser, or until the purchaser threw it out of his plant, then some adjustment would be negotiated!

Addition of lime to coal *will* make changes other than making coal white, the *News* continues. The correct amount of lime will improve the fusion temperature of the ash, but the results can be detected only in the laboratory. Addition of lime is not recommended in boiler room operation. Sand or silica will make coal ash clinker, but will also fuse the stoker parts together. Common salt (NaCl) will change the caking characteristic slightly — so little that one's imaginative power has to be stressed. One of the most powerful oxidizers in the chemical field is potassium, but it would take 72 tons of potassium chlorate to provide enough oxygen to burn a ton of coal.

One of the favorite methods of injecting additive chemicals is by means of an air or steam injector in the furnace which blows the chemical into the fire. If it is noticed that combustion results are improved, NCA suggests running the injector without the chemical additives. If the results are the same, it may be that the installation of overfire air jets would improve the operation of the boiler furnace. If the installation already has overfire air jets, it may indicate that they should be relocated.

ASHRAE LABORATORY MOVED TO KANSAS STATE CAMPUS

The ASHRAE environmental research laboratory, said to be the world's largest and best equipped, is being transferred to Kansas State University, Manhattan, Kan., for K-State's Institute for Environmental Research.

The Laboratory and its associated equipment represents an investment of approximately $150,000. It will be housed in a $160,000 building for which the University received an $80,000 National Institutes of Health grant.

Under an agreement between the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., and the University, K-State will carry on several of the Society's current research projects, with the Society financing this research on a cooperative basis. A number of other outside sources will be contributing substantial support to the research programs planned for the Institute.

Dr. Ralph Nevins, head of the mechanical engineering department in K-State's School of Engineering and Architecture, will direct the new Institute.

In addition to the ASHRAE-KSU environmental room, Institute facilities will include an air-pollution laboratory, a biological heat-transfer laboratory, an instrument room and office space.

The Society has operated its environmental laboratory for a number of years and just this past year completed a series of experiments to re-evaluate the ASHRAE comfort chart which was based on research done in the 1930's. When ASHRAE decided recently to expand its research program and to close its research laboratory in Cleveland, it agreed to transfer the environmental laboratory to Kansas State University so that the environmental research program might be continued.

Prospective Students of Engineering College Gets Preview of Air-Conditioning Curriculum

Thirty-six high school junior and senior boys will get an exciting "preview" of the world of air-conditioning next month in a three-day program of lectures and demonstrations at California State Polytechnic College, San Luis Obispo. The Second Annual Engineering Preview is sponsored by Western Air Conditioning Industries Association.

Each student selected by the engineering faculty will receive a grant of fifty dollars to cover his transportation, board and room. Purpose of the preview, according to Cal Poly, is to give the boys a "brief survey of one of the many subject areas in engineering as a basis for understanding the nature of engineering as a career."

Included in the program which begins on Sunday evening, December 17, is an introduction to heat energy, laboratory demonstrations of temperature measurement, lectures on sea water conversion, thermo-electric cooling, aero-space vehicles, and the human body, all by members of the engineering faculty. An introduction to types of computers will be followed by laboratory demonstrations of the use of analog and digital computers in the solution of engineering problems.

At a banquet in the College Dining Hall, Arthur Hess, vice-president of the sponsoring Association, will speak on the air conditioning and refrigeration engineer's part in the nation's space program.

BRI TO SEVER TIES WITH NATIONAL ACADEMY

Building Research Institute will assume the status of an independent, nonprofit technical society of building science during the coming year. The Institute is a unit of the Division of Engineering and Industrial Research, National Academy of Sciences-National Research Council.

The change of status, contemplated ever since BRI came into

(Continued on page 16)

MARRIOTT RESORT
MOTOR HOTEL . . . . .

Fabulous

and
air conditioned with
311 McQuay individual
room Seasonmakers

McQuay INDIVIDUAL ROOM SEASONMAKERS

4 types, 220 to 1240 cfm
Floor—Hideaway—Basic—Ceiling

MARRIOTT MOTOR HOTEL, DALLAS
Architect—Harold Berry
Consulting Engineer—Herman Blum
General Contractors—Tenyck & Shaw
Mechanical Contractors
George Linskie Co., Inc.

McQuay

The fabulous Marriott Motor Hotel of Dallas, Texas, was created to supply its many guests with all the luxury and comfort that gracious living can offer.

One important Marriott luxury feature is the individual room controlled air conditioning supplied by 311 McQuay Seasonmaker air conditioners which enable occupants to comfort condition their rooms to their personal desire.

Engineers, architects and contractors agree that McQuay Seasonmakers offer the flexibility, dependability, advanced design features and the economy that make them ideal for all hotel, motel, apartment or office installations. Contact your local McQuay representative for the complete Seasonmaker comfort conditioning story, or write McQuay, Inc., 1619 Broadway N. E., Minneapolis 13, Minnesota.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

BRI TO BE INDEPENDENT

(Continued from page 14)

being ten years ago, will enable it to further broaden its activities in the stimulation of needed new building research, to administer co-operatively sponsored research projects, and to accept grants for the execution of valuable projects consistent with its purposes.

BRI will continue to function as a membership organization, presenting its popular, semi-annual research correlation conferences, developed by committees of its members, and publishing the technical reports of its meetings for distribution to members and for sale to the scientific public.

Announcement of the change was made by Leon Chatelain, Jr., FAIA, BRI president. Institute members expect to convene for their 1961 Fall Conferences on November 28-30 at the Mayflower Hotel, Washington, D. C., where a program of six separate conferences will deal with: Prefinishing of exterior building components; Performance of plastics in building; Mechanical fasteners for wood; Identification of colors for building; Building cost analysis; and Design for the nuclear age. The conferences are open to the interested public.

Den in the home of Dr. Arthur Kuhn near Hammond, Ind., is shown with decorative plate coils of copper along the ceiling, part of Reflectotherm system that uses valence panels for radiant heat input into or removal from occupied spaces plus low-pressure ventilating system.

"NEAR PERFECT" CONDITIONING PASSES TWO SEVERE TESTS

Dr. Clarence A. Mills, professor of experimental medicine at the University of Cincinnati and originator of the Reflectotherm method of reflective radiant conditioning, announced completion of two severe tests in which "the world's most nearly ideal system of year-round space conditioning" met all expectations.

One test took place in an addition to a clinic at 112 Rimbach Street, Hammond, Ind., where the system was installed three years ago; the other in the home (near Hammond) of Dr. Arthur Kuhn, where the installation was made two and one-half years ago. Thus the new method of space conditioning has been tested for three summers and three winters in the clinic and for three winters and two summers in the home.

Copper Tube-In-Strip, made by Revere Copper and Brass Incorporated, is used as an important part of the Reflectotherm heating and cooling system. Tube-In-Strip is a solid piece of flat sheet or strip copper with built-in passages that may be inflated by pressure into tubes. Thus, the tubes became an integral part of the copper sheet.

Dr. Mills' system uses valance panels made of Tube-In-Strip for radiant heat input into or removal from occupied spaces while exercising control of humidity and dirt through air constantly introduced under low pressure for the purpose of ventilation.

Reflective radiant conditioning is said to provide a continuous flow of fresh air, free of dust, smog, fumes and pollen, and to give maximum winter comfort, free of chilling "cold wall" effects, at air temperatures from 8 to 10 deg F below those needed in a similar warm-air heated structure and at a fuel saving of roughly 40 per cent.

Structural savings made possible by use of the system are said to be considerable. In a modern house of large glassed areas such as the Kuhn home, only single plate glass need be used, with savings equal to a large portion of the system cost. Heat transfer through side walls, winter and summer, can be disregarded if proper overhangs, now generally included in residential architecture, are provided.

The building structure otherwise can be skeletonized except for blockage of solar heat ingress through the roof. Storm windows and doors, screens, and weather stripping are not needed and openable windows can be reduced to the minimum demanded for each room by local building codes.

All these structural savings are said to add up to a sizable credit on the system's cost. The tests conducted on both cooling and heating in the Hammond installations have shown that the system developed by Dr. Mills works with maximum effectiveness throughout the year.

(More news on page 132)

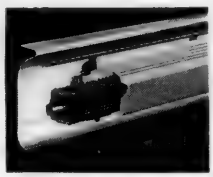
Ray Edwards Says: **HERE'S A PROMISE THAT WILL HELP YOU MAKE THE BEST HEATING CHOICE . . .**

UP TO 30% SAVINGS ON FUEL COSTS!

EDWARDS ZONE CONTROL IS THE ANSWER

Edwards Zone Control hydronic system saves money for your clients. The owners of apartments or commercial buildings with separately controlled zones save up to 30% in fuel. A non-zone system is a waste-heat system. Heat is scattered all over the building, mostly in places where it is not needed. Edwards Zone Control system keeps the un-used rooms from being supplied with heat until actually needed. Results? Fuel saving.

Learn more about Edwards Zone Control hydronic heating for commercial and residential installations. Write for our 210 page catalog — handbook containing engineering specifications. This catalog also includes full details on Edwards Electro-Hydronic "Off-Peak" heating system as well as on Airvec Packaged Cooling. Send today for your copy.



EDWARDS PACKAGED HYDRONICS —
Boilers, zone valves, circulators and baseboard radiation

MAIL COUPON TODAY!

EDWARDS ENGINEERING CORP.
Pompton Plains, N. J.
TEmple 5-2808

Yes, we are interested in:

- ☐ Your 210 page Catalog
- ☐ Your 17" x 22" Engineers Portfolio

NAME _____

COMPANY _____

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CITY _____ STATE _____

ACHV-11

The Arkla Gas air conditioning unit uses the same gas-fired boiler that heats in winter to cool in summer.

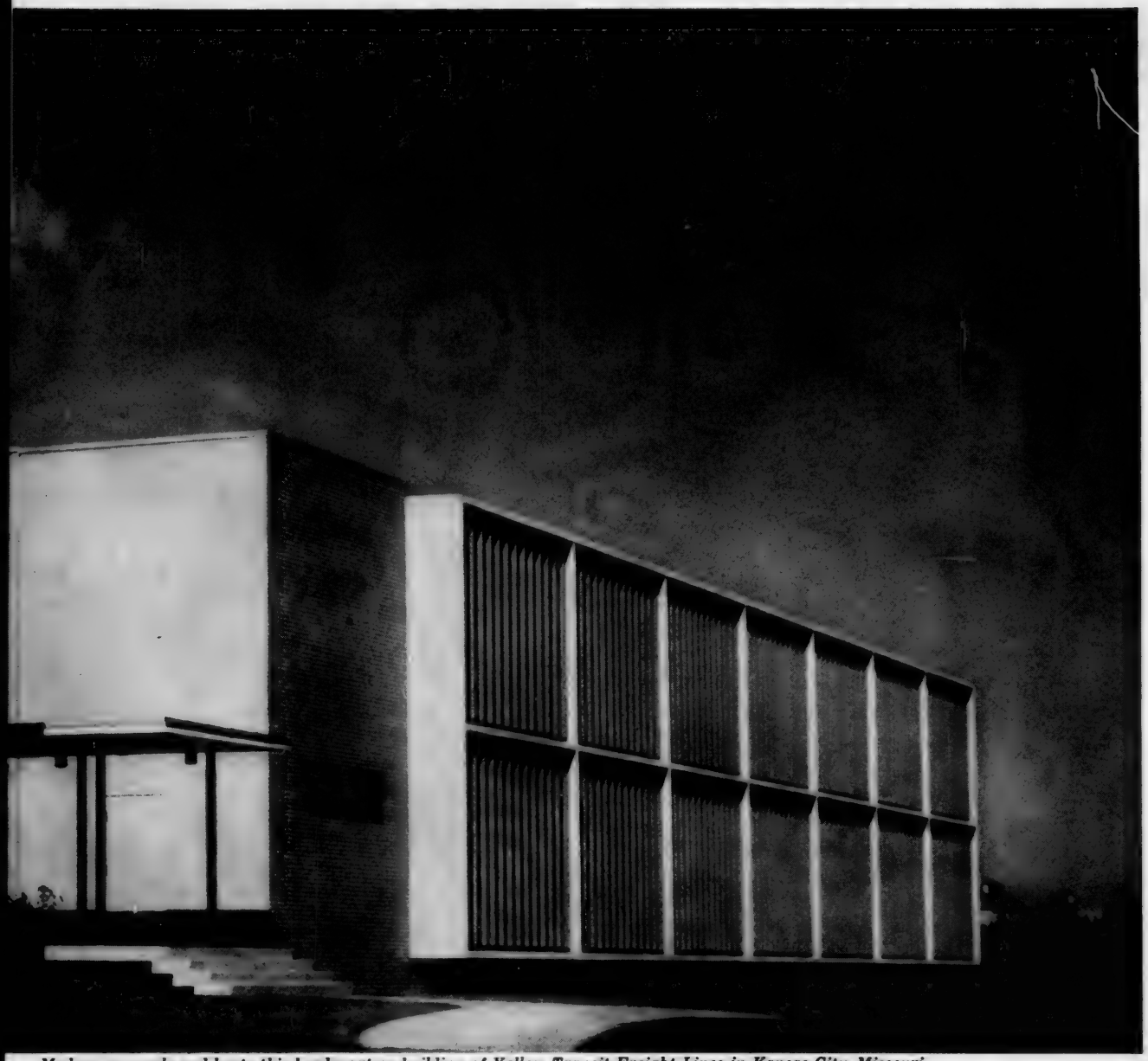
As the Building grows, the ARKLA

The headquarters building of Yellow Transit Freight Lines, Kansas City, Missouri, was designed to take a third story without major alterations. That's why they chose Arkla gas cooling units . . . a system that can "grow" quickly and at low cost.

When the building expands, they'll just add an Arkla unit. They go on the line right next to the rest, using the same basic piping – and steam from the same gas-fired boiler that energizes all the Arkla units.

The present cooling system includes five 25-ton Arkla Gas

Architect: Folger & Pearson;
Mechanical Contractors: Troug & Nichols.



Modern gas cools and heats this headquarters building of Yellow Transit Freight Lines in Kansas City, Missouri.

GAS COOLING system grows with it

Absorption Water Chillers. These versatile units use steam from the gas-fired boiler to provide chilled water for comfort cooling. The same boiler heats in winter. And thrifty gas keeps fuel costs low.

For specific information on Arkla gas air conditioning, call your local Gas Company. Or write Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Arkansas. *American Gas Association.*

FOR HEATING & COOLING...GAS IS GOOD BUSINESS!

For increased cooling capacity, at low cost, additional Arkla units can be installed.

Steel
SOFTITE BY WHEELING
COP-R-LOY

"First choice by far!"

—That's what they're saying all over America about Wheeling SOFTITE Galvanized Sheets! For SOFTITE has everything sheet metal men want in a galvanized sheet. Here's why:

1. SOFTITE sheets work easier because they are soft and ductile.
2. SOFTITE's galvanized coating is applied so tightly that it actually becomes a part of the steel base . . . can't flake or peel no matter how you twist or torture it.
3. SOFTITE, made of famed Cop-R-Loy, lasts longer . . . will give more years of extra service for your customer's dollar.

Get the full facts on dependable, easy-to-work SOFTITE Galvanized Cop-R-Loy Steel Sheets from your Wheeling man this week. Or write directly to our nearest sales office.

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FOR AIR CONDITIONING . . .

Get exact water control through

Exclusive Honeywell design makes the difference in pneumatic valves!

CHECK THESE HONEYWELL DIFFERENCES:

THE ACTUATOR

1 **Rolling-type diaphragm** assures constant effective area throughout stroke, provides maximum power when needed.

2 **Snap-seal** bead on diaphragm. The higher the pressure, the tighter the seal.

3 **Bullseye stem button design** maintains smooth stem travel, eliminates side thrust, assures positive positioning.

THE VALVE

4 **Specifically designed** to modulate hot and cold water in sequence.

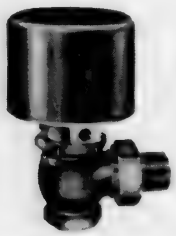
5 **Two contoured plugs** insure equal percentage output for either hot or cold flow.

6 **Body is a brass forging** and all internal parts are brass or stainless steel with rubber seals.

7 **Spring-loaded, self-adjusting** rubber packing rings eliminate field packing adjustments.

The Honeywell VP522A is the only modulating sequencing valve specifically designed to control the flow of both hot and cold water to fan-coil and induction units. This three-way, pneumatically-operated valve assures maximum power when you need it most—when the valve is approaching the closed position. The flexible, rolling-type diaphragm keeps the effective area of the actuator constant, regardless of the position of the diaphragm itself. Bullseye action by the stem retainer and contoured plug prevents side thrust, provides more sensitive, precise flow control.

The assembly is corrosion resistant. Molded-in composition discs assure tight shut-off. Two inlets and a common outlet are threaded for ½ inch, ⅜ inch and ⅞ inch OD flare fittings to cover the additional requirements of this valve. Only Honeywell offers this selection. And the actuator can be rotated 360° on the bonnet, permitting easy alignment with air piping from any direction. For full details, call your nearest Honeywell office. Or, write Honeywell, Dept. HV-3-79, Minneapolis 8, Minnesota. In Canada write Honeywell Controls, Limited, Toronto 17, Ontario.

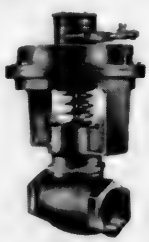


Pneumatic Radiator Valves VP520A, VP520C

Direct-acting, normally open, single-seated valves in straight-through, straight-through offset or angle patterns. VP520A is modulating for two-pipe steam and hot water systems. VP520C is used with a 2-position controller on one-pipe steam systems.

Three-way Pneumatic Coil Valve V5013A

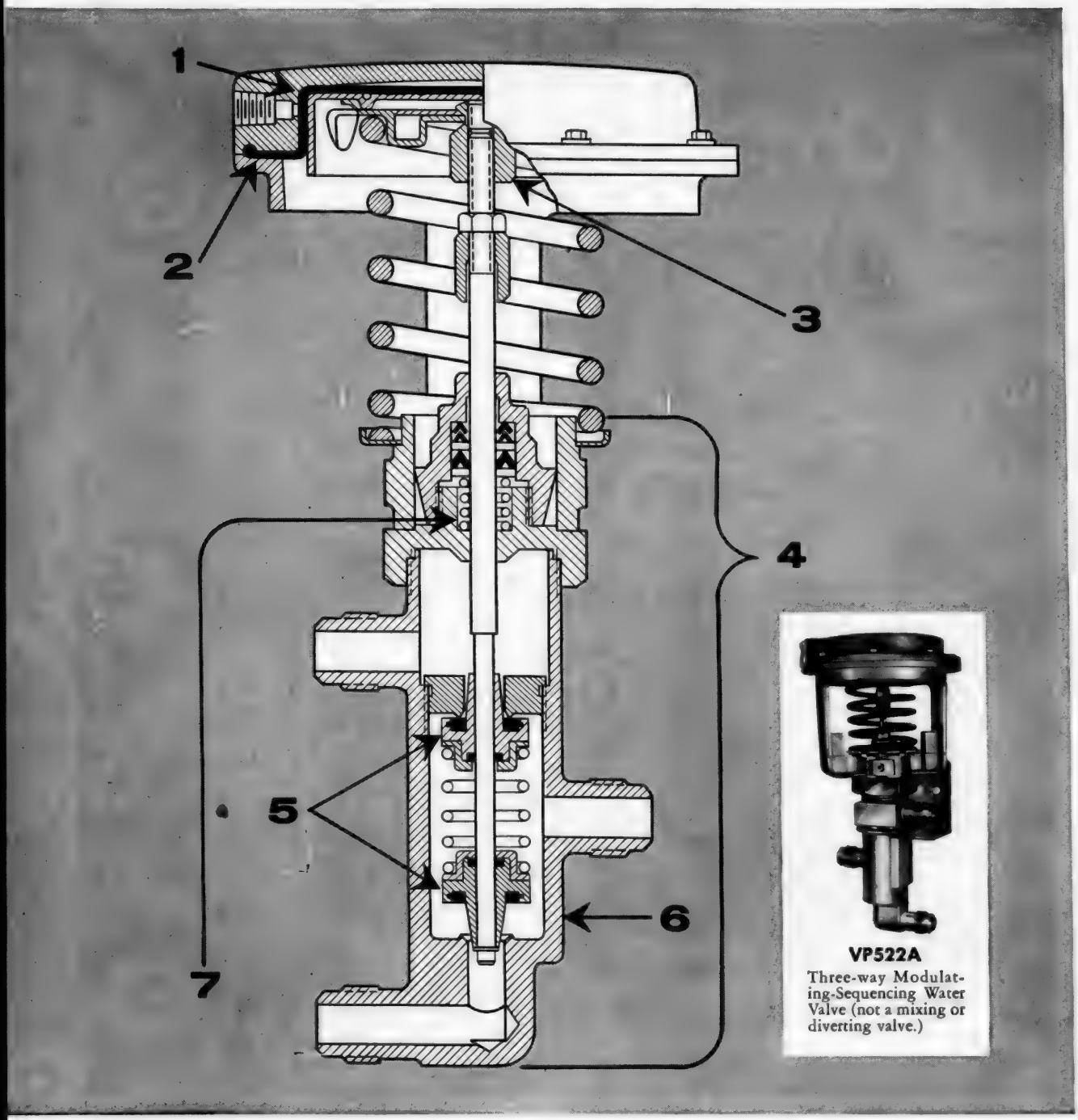
Can be used for mixing service to direct two inlets to a common outlet. Should not be used to divert flow from a common inlet to two outlets. For use with pneumatic, electric or electronic operators to form a motorized valve assembly for the control of hot or chilled water.



Single-Seated Valve Bodies V5011A, V5011B

Straight-through, globe-type valves with cast-bronze screwed ends or cast-iron flanged ends. V5011A is direct-acting. V5011B is reverse-acting. Excellent flow control is achieved by using equal-percentage, high-lift, plug-type throttling guides.

"Constant Power" actuation



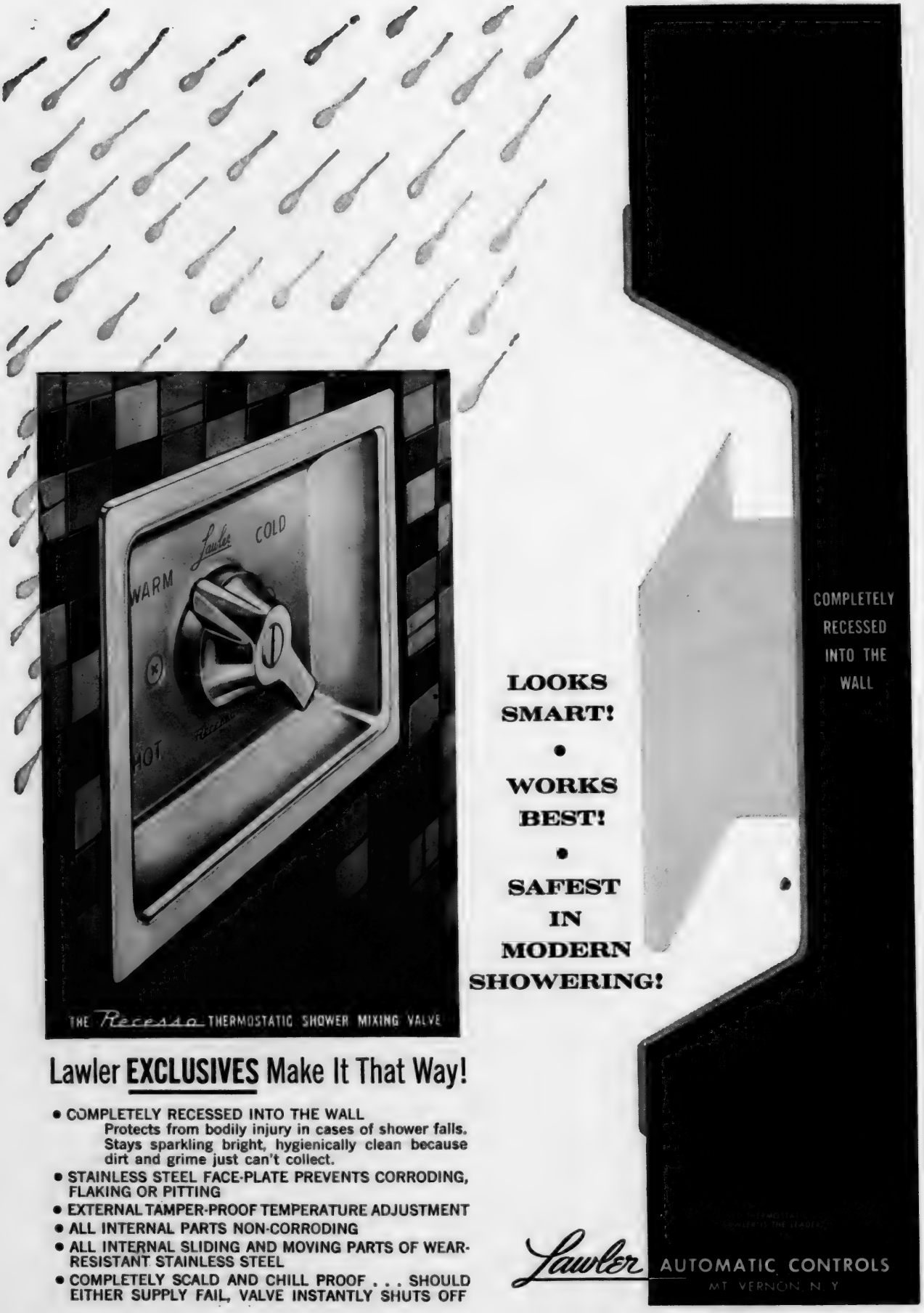
VP522A
Three-way Modulating-Sequencing Water Valve (not a mixing or diverting valve.)

Honeywell

First in Control

SINCE 1885

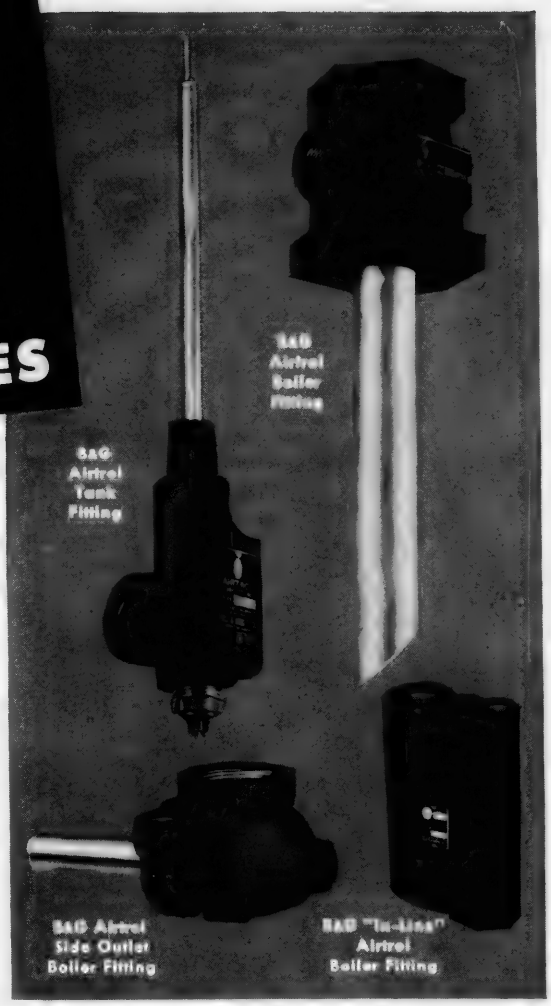
HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



Lawler **EXCLUSIVES** Make It That Way!

- COMPLETELY RECESSED INTO THE WALL
  Protects from bodily injury in cases of shower falls. Stays sparkling bright, hygienically clean because dirt and grime just can't collect.
- STAINLESS STEEL FACE-PLATE PREVENTS CORRODING, FLAKING OR PITTING
- EXTERNAL TAMPER-PROOF TEMPERATURE ADJUSTMENT
- ALL INTERNAL PARTS NON-CORRODING
- ALL INTERNAL SLIDING AND MOVING PARTS OF WEAR-RESISTANT STAINLESS STEEL
- COMPLETELY SCALD AND CHILL PROOF . . . SHOULD EITHER SUPPLY FAIL, VALVE INSTANTLY SHUTS OFF

B&G AIRTROL® SYSTEM ...THE TO END AIR TROUBLES


B&G Airtrol Tank Fitting
B&G Airtrol Boiler Fitting
B&G Airtrol Side Outlet Boiler Fitting
B&G "In-Line" Airtrol Boiler Fitting

In thousands of hot water heating systems, the B&G Airtrol System is providing a *guaranteed* service in curing air troubles. This patented B&G equipment prevents air-bound radiation, waterlogged compression tanks, gurgling pipes... ends profitless call-backs. *It eliminates the need for automatic air vents!*

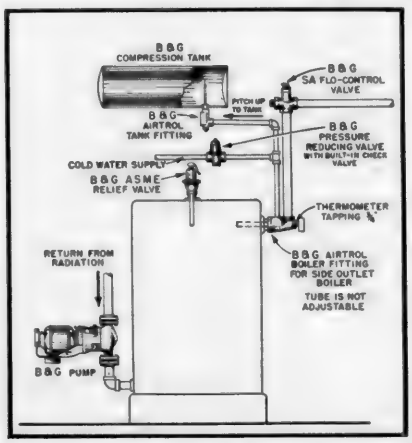
The B&G Airtrol System is simplicity itself. It consists of two easily installed parts—the Boiler Fitting and the Tank Fitting. Their combined function is to trap air in the compression tank and prevent its return to the boiler, piping and heat distributing units. All air bubbles are caught where they form—*in the boiler!*

Any forced hot water system, *regardless of size*, can be equipped with a B&G Airtrol System.

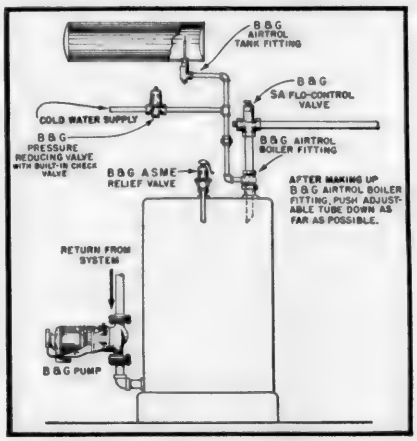
For full information on the only *guaranteed* method of controlling air in hot water systems, send for Bulletin HM-456.

GUARANTEE!

B&G Airtrol® Systems are guaranteed to prevent the accumulation of air in heating units, and prevent noises caused by entrained air in piping. In case of failure of any B&G Airtrol System (within the U.S.A.) to operate correctly, when installed in accordance with our published instructions, we will provide, free of charge, the services of a factory-trained engineer, who will supervise changes required to provide satisfactory results.


B&G COMPRESSION TANK
B&G SA FLO-CONTROL VALVE
PITCH UP TO TANK
B&G AIRTROL TANK FITTING
B&G PRESSURE REDUCING VALVE WITH BUILT-IN CHECK VALVE
COLD WATER SUPPLY
B&G ASME RELIEF VALVE
THERMOMETER TAPPING
RETURN FROM RADIATION
B&G AIRTROL BOILER FITTING FOR SIDE OUTLET BOILER
TUBE IS NOT ADJUSTABLE
B&G PUMP

Installation of B&G Airtrol System on side outlet boiler


B&G AIRTROL TANK FITTING
B&G SA FLO-CONTROL VALVE
COLD WATER SUPPLY
B&G PRESSURE REDUCING VALVE WITH BUILT-IN CHECK VALVE
B&G AIRTROL BOILER FITTING
B&G ASME RELIEF VALVE
AFTER MAKING UP B&G AIRTROL BOILER FITTING, PUSH ADJUSTABLE TUBE DOWN AS FAR AS POSSIBLE.
RETURN FROM SYSTEM
B&G PUMP

B&G Airtrol System installed on top outlet boiler

The world's most complete line of Hydronic equipment

BELL & GOSSETT
COMPANY
Dept. GW-4, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

Oh Brother!!!!

. . . . to think I could have given my client Individual Zone Control for every office had I used

CARNES NEW LOW-VELOCITY DUAL-DUCT ATC UNITS

For the fastest relief of your zone control headache, take the perfect remedy that incorporates all the inherent advantages of dual-duct "pin-point" room control and low velocity. At the same time, slash your job cost, simplify ductwork, and increase operating efficiency.

For the closest room temperature control, coupled with the quickest response to changes in heating and cooling loads . . . specify Carnes new, completely packaged Low-Velocity Dual-Duct Acoustic Terminal Control (ATC) Units. Backed by quality controlled production techniques, accurately tested and rated for performance and sound power level, these units insure complete on-the-job satisfaction. On your next project, compare the many advantages of a low-velocity dual-duct system over other methods of air distribution.

Advantages over high-velocity dual-duct system

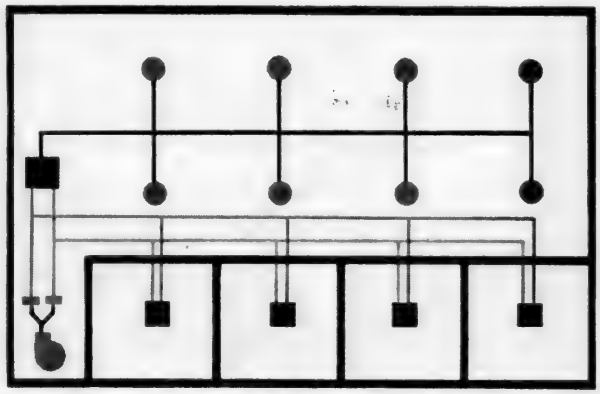
A less costly fan, smaller horsepower motor and reduced electrical power can force the same quantity of air through larger low-velocity ductwork, when space limits do not demand smaller high-velocity ducts. Less system noise reduces acoustical control components. Low-velocity cuts installation cost, ductwork need not be leakproof . . . slight leakage is often desirable, thus sealing and welding of seams and joints are eliminated. Fittings need not be so precisely made; lighter gauge material is approved. System static-pressure unbalance is controlled by conventional methods . . . constant volume devices in each unit not required.

Advantages over multizone system

More zones are permitted by dual-duct system . . . hot and cold mains or branches can be tapped off to a terminal control unit at each specified space. Same amount of available ductwork space accommodates a greater number of zones.

Advantages over reheat system

Temperature of supply air — in a reheat system — must be maintained to satisfy the room with the greatest cooling load; reheat coils require year-round steam or hot water. In a low-velocity dual-duct system, the hot coils need not be operated during the cooling season — tempering is done by outside and recirculated air. Also, coils are centrally rather than separately located, cleaning and maintenance are thus simplified, and the dual-duct system can also respond more quickly to load change.



Private offices in this small office building are provided with individual low-velocity ATC units. The general office area is supplied by one large low-velocity ATC unit.

Carnes Offers A Complete Range of Models and Sizes

2 CEILING MODELS
End Discharge.....5 sizes
Bottom Discharge.....5 sizes

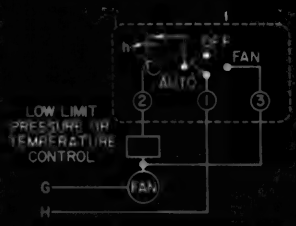
2 WINDOW PERIMETER MODELS
Top Discharge.....2 sizes
Front Discharge.....2 sizes

CARNES®

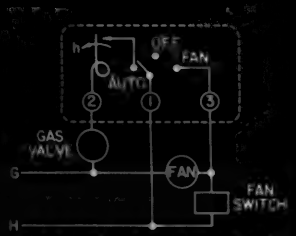
LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION

CARNES CORPORATION, VERONA, WISCONSIN / CANADIAN SUBSIDIARY: WEHR AIR EQUIPMENT COMPANY, LTD., 86 GERTIE STREET, WINNIPEG 2, CANADA.

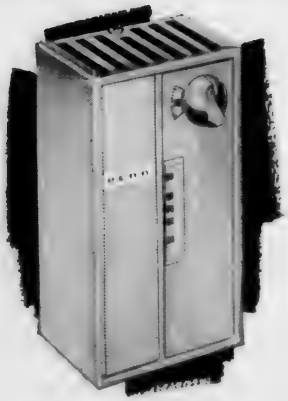
NEW UNIT HEATER THERMOSTAT



Typical application of Type 822A7 with AUTO-OFF-FAN selector on steam or hot water coil unit.



Typical application of Type 822A7 with AUTO-OFF-FAN selector on gas-fired unit heater.



Series 822, with or without function selector knob, rated for ¼ hp. service. Series 824, without function selector, is rated for 1 hp. service.

features easy-to-use, locking-type knobs for heating and summer ventilation

Here's the modern line-voltage thermostat with beautiful "slim-line" styling. Its built-in AUTO-OFF-FAN selector assures year 'round efficiency of unit heaters . . . saves fuel in winter . . . provides ventilation in summer.

It has easy-to-read temperature and function selector dials. It has exclusive, locking-type adjusting knobs, attached to cover but connected to adjusting shafts by factory-installed "keys" within the knobs. It has a built-in, concealed adjustable high limit stop for temperature dial. It has low operating differential at all voltages and amperages within its rating. It has easiest field wiring ever . . . simply connect to large terminals *on back of thermostat*. And, it has many more features you'll want. Learn more about this better thermostat for unit heaters . . . write to the Penn factory.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

When ANEMOSTAT is in sight the system is RIGHT

Anemostat offers a complete range of air diffusion equipment for every engineering and architectural need. You can specify exactly the unit you need for conventional or high-velocity systems. In fact, when Anemostat air diffusers are in sight, you can be sure the system is right.

As a result of scientific research and development — plus experience gained in tens of thousands of installations—we have consistently improved the quality and performance of Anemostat products. There is still no "or equal" for ANEMOSTAT.

ANEMOSTAT®

ANEMOSTAT CORPORATION OF AMERICA

A Subsidiary of **DYNAMICS CORPORATION OF AMERICA**

Factory and General Offices: 888 North Keyser Avenue, Scranton, Pa.
National Sales Office: 25 West 43rd Street, New York 36, N. Y.
Representatives in Principal Cities

AC-1304

LIKELY TO BE THE SMALLEST ITEM IN THE BUILDING MAINTENANCE BUDGET!

■ And by small, we mean small . . . as little as 1½¢ per valve per year according to records from THE STEVENS HOTEL (Conrad Hilton), Chicago, where 3600 ROYAL Flush Valves continue in dependable daily service after 35 years.

In THE EMPIRE STATE BUILDING, New York, Mr. Donald Gibson, Staff Engineer, says Sloan Flush Valves have caused practically no maintenance problems since the opening of that fabulous building.

These experiences are typical of Sloan and especially significant when you consider the hard use and abuse to which Sloan Flush Valves are often subjected in the public toilet rooms of hotels, office buildings, airports, schools, etc.

Such experiences account for Sloan leadership. And Sloan leadership is maintained through a constant effort to make our flush valves even better. Better in design, better in materials, better in workmanship.

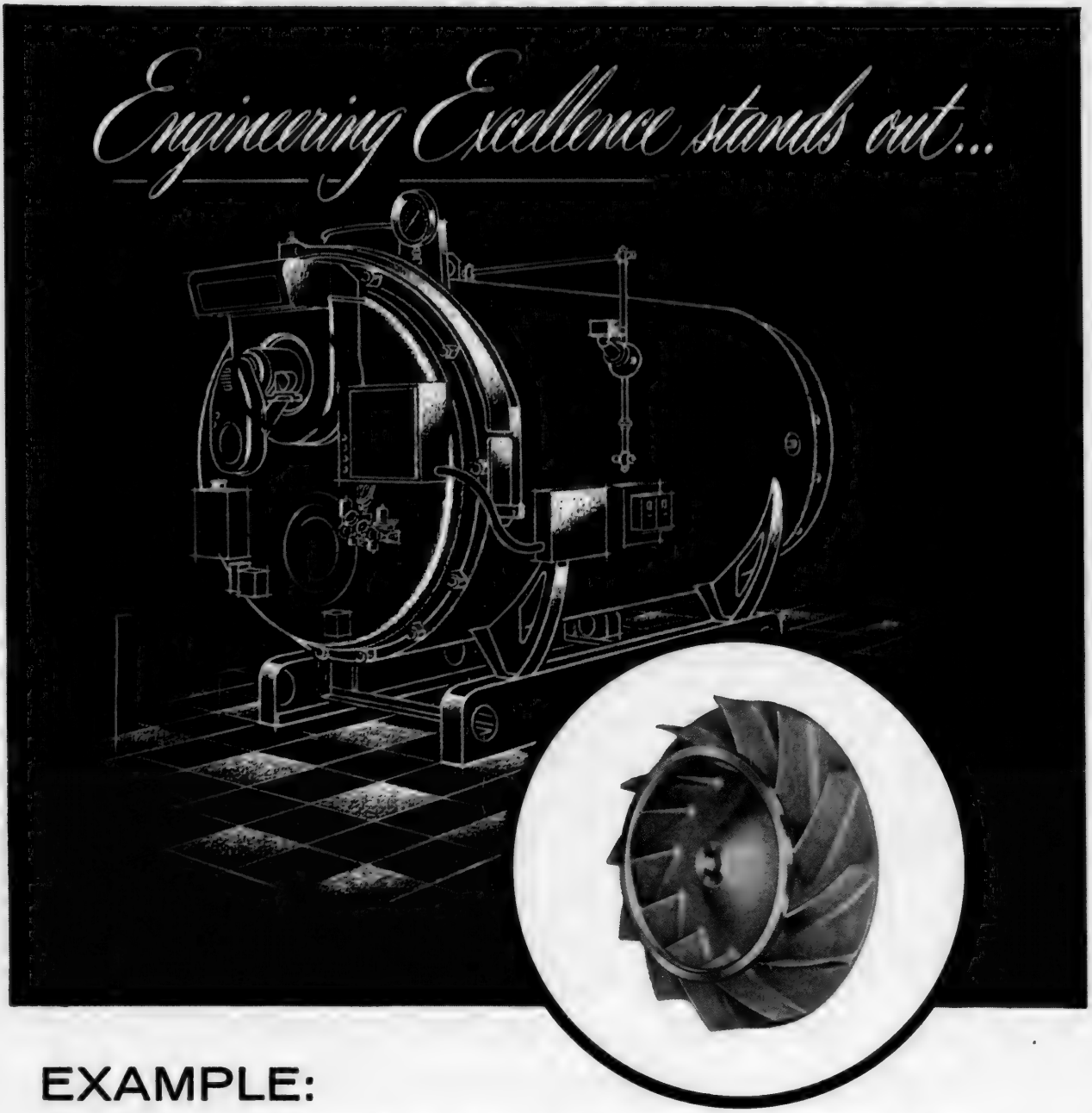
Because the Sloan ROYAL is acknowledged as the world's most successful flush valve, attempts have been made to imitate some of its most important features. But why gamble with substitutes when you can plan for the life of the building confidently with Sloan? Specify performance-proven, time-tested Sloan Flush Valves.

SLOAN

FLUSH VALVES

SLOAN VALVE COMPANY • 4300 WEST LAKE STREET • CHICAGO 24, ILLINOIS

Engineering Excellence stands out...



EXAMPLE:
Cleaver-Brooks exclusive *caseless fan*

This patented fan is the heart of a highly efficient forced draft system. Unique in design and function, this caseless impeller — made of sturdy cast aluminum, located deep within the front head of the boiler — provides combustion air at the required pressure and in the proper quantity to assure you of peak efficiency at any load level.

Efficiency extends into the area of maintenance, too. This fan never needs cleaning. Direct drive connection, without special bearings or V-belts, keeps the operation free from trouble... contributes to the quietest operation for any boiler you can buy today. Good reason why you should *insist* on Cleaver-Brooks.

Your Cleaver-Brooks agent has years of experience in boiler application. Contact him for more information on the features that exemplify the engineering excellence of Cleaver-Brooks.

Write for free booklet, "How to Select a Boiler."

Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER
OF PACKAGED BOILERS
Dept. M, 315 E. Keefe Ave., Milwaukee 12, Wis.

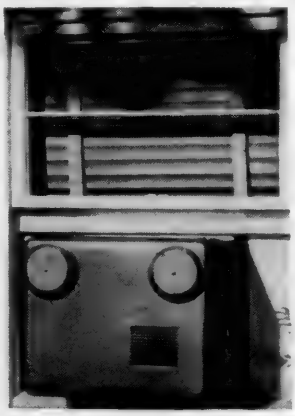
PERFORMANCE PROVES THE ENGINEERING EXCELLENCE OF CLEAVER-BROOKS BOILERS

31-61

Solve Small Space Heating Problems with Suburban Novent-Dynavent GAS Heaters

Heat by the roomful...that's what you get when you specify Suburban Novent or Dynavent Gas heaters. No need to heat unused or unoccupied rooms. No flue or chimney needed. Ideal for added rooms, cabins, playrooms, closed-in breezeways, offices and garage workshops.

Suburban Novent and Dynavent Gas heaters give you all the advantages of modern gas heat . . . high efficiency, precise control, speed, cleanliness, economy and dependability of supply. Gas can be the answer to your unusual or everyday heating problems.



Right: These units are installed at the Price Apartments, Nutley, New Jersey (shown above). Each apartment is individually heated to exactly the temperature desired by the occupants.

Heat better for less with Suburban Novent or Dynavent Gas heaters. For complete information, contact your local Gas Company, or write to Suburban Appliance Co., Dept. AV 1161, Morristown, New Jersey.

American Gas Association

FOR HEATING... GAS IS GOOD BUSINESS!

ANNOUNCING

JOHNSON CONTROL CENTER MODULES

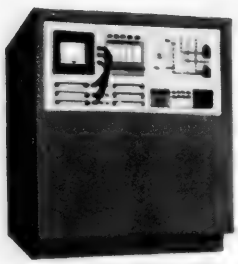
The most advanced development in centralized temperature control, new Johnson modular units permit complete flexibility in control center design and operation. They are adaptable to all transmission systems — pneumatic, electric, electronic.

Besides temperature control, many other functions, such as lighting control, power plant control, communications, and alarm systems, may be integrated into the center. The wide choice of features ranges from conventional data indication and control to automatic digital printing, closed-circuit TV, and screen-projected floor plans and system diagrams. You use as many or as few modules as you wish. Each module is custom-equipped.

Johnson Control Centers are ideal for both new and existing systems in commercial, industrial, and public buildings of any size. For examples of how these compact modular units can be combined to increase system efficiency and make more effective use of manpower, turn the page . . .

Keyed to the Needs of the Individual Building...

Johnson Control Center Modules offer unmatched opportunities for systems efficiency and savings. Check the features of this typical grouping and see why.



MISCELLANEOUS DATA MODULE

Pneumatic indicating receivers, mounted horizontally or vertically, provide continuous indication of key temperatures and pressures. Integral switches indicate off-normal conditions. Optional recording of variables is provided by three-pen, plug-in recorder. Interlocked circuits provide automatic sequence motor control of refrigeration system. Visual indication of operation, manual override, and graphic diagram of the system are also included.

CONTROL CONSOLE

Contains digital clock, digital indication of variables, visual and audible alarms, and intercom system. Master switches determine mode of operation of digital indication and logging. Switches include master on-off, off-normal scan, all-point scan, point hold, scan locked out, printer locked out, off-normal alarm release, audible alarm release, audible alarm locked out, and audible alarm test. Centralized security checks and alarms can easily be included also.

DATA LOGGING MODULE

A high-speed, automatic digital printer provides the building engineer with a permanent record of control data. All off-normal values are printed in red; normal values are printed in black. With parallel print-out, all keys print simultaneously, thus speeding data collection. Logging rate is adjustable up to one point per second. Using Johnson modules, a single center can provide centralized supervision and control for as many as a dozen or more buildings!

Johnson Modular Units Allow You to Centralize All Types of Systems Supervision and Control

AIR CONDITIONING — HEATING

Continuous visual indication of key temperatures, humidities, pressures, liquid levels, etc.

Continuous or optional recording of variables.

Automatic data logging of variables.

Boiler surveillance: steam, oil, and gas pressures; oil level; boiler alarms.

Manual or automatic start-stop controls for fans, pumps, and motors; indicator lights.

Remote sound or TV surveillance of fan room equipment.

Metering of power, water, other services.

Refrigeration machine indication and control.

Summer/winter switchover.

Remote temperature reset.

Indication of filter conditions, valve and damper positions, fuel reserves.

High-low limit alarms.

GRAPHIC DIAGRAMS

Color coded representation of system and equipment on panels or screen-projected slides.

FIRE AND RAID ALARMS

Fire detection system with central alarm and location indication.

Conelrad air raid warning tied into central alarm and communication systems.

CLOCK SYSTEMS

Centralized programming of master and individual clocks and time signals.

SECURITY SURVEILLANCE

Closed circuit TV from remote areas.

Audible alarms; sound detection.

LIGHTING SYSTEMS

Manual or automatic programming.

Light level controls.

COMMUNICATIONS

Master intercom and music systems.

Paging center.

Closed circuit TV and radio intercom for remote supervision of repairs and installations.

MISCELLANEOUS SYSTEMS

Snow melting, lawn and sprinkler systems, control.

Time recording systems, machine operations.

Indication of gas, radiation, or other hazardous conditions.

Transformer indication and control.

Indication and control of boiler and turbine operations.

Feed water conductivity, analysis, and flow.

Domestic hot water control.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

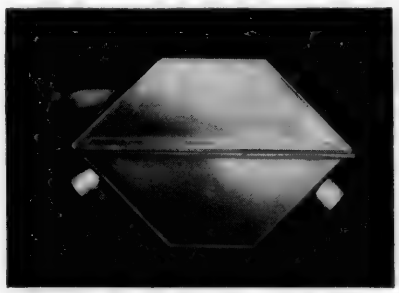
For details about Johnson Control Centers, write for Bulletin 1040.
Johnson Service Company, Milwaukee 1, Wisconsin.

Printed in U.S.A.

twenty three million bubbles stronger

Bubbles make Buensod's new, improved air mixing valve stronger . . . 23,000,000* bubbles stronger. Research has led us to fill these new valves with polyurethane foam. The result is a better insulated valve with improved acoustical characteristics and far greater structural strength. And although the quality has gone up, the price hasn't.

This improvement is typical of the way Buensod-Stacey does business . . . always planning for a better product. The company that pioneered and developed Dual-Duct high velocity air conditioning has never stopped refining this advanced method of year 'round conditioning. There's a place for Dual-Duct in your next project, whether new structure or renovation. Your local Buensod rep will be glad to help. Call him.

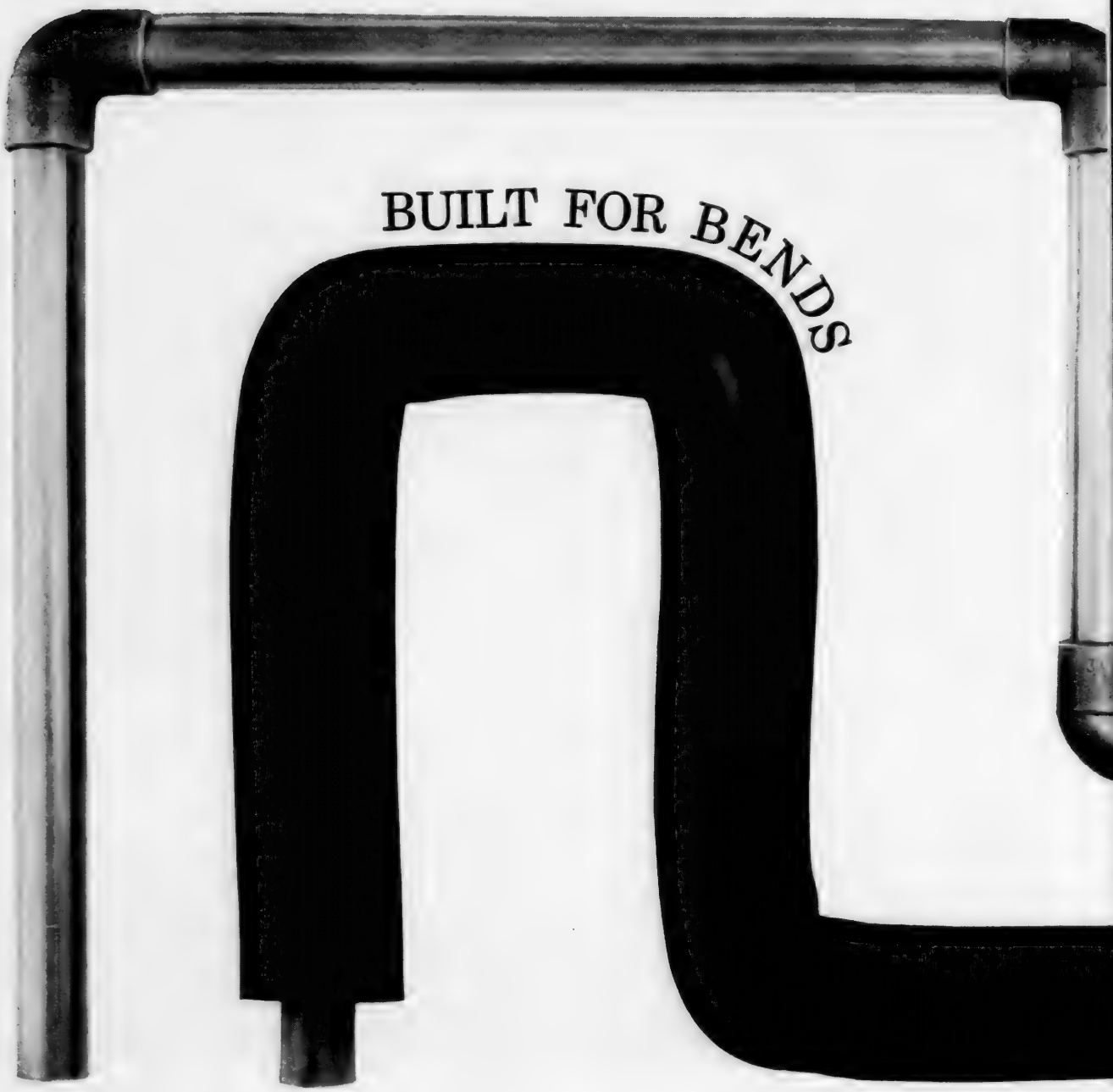


*Approximate number of polyurethane foam cells found in the air mixing valve of Buensod-Stacey Type V under-window unit.

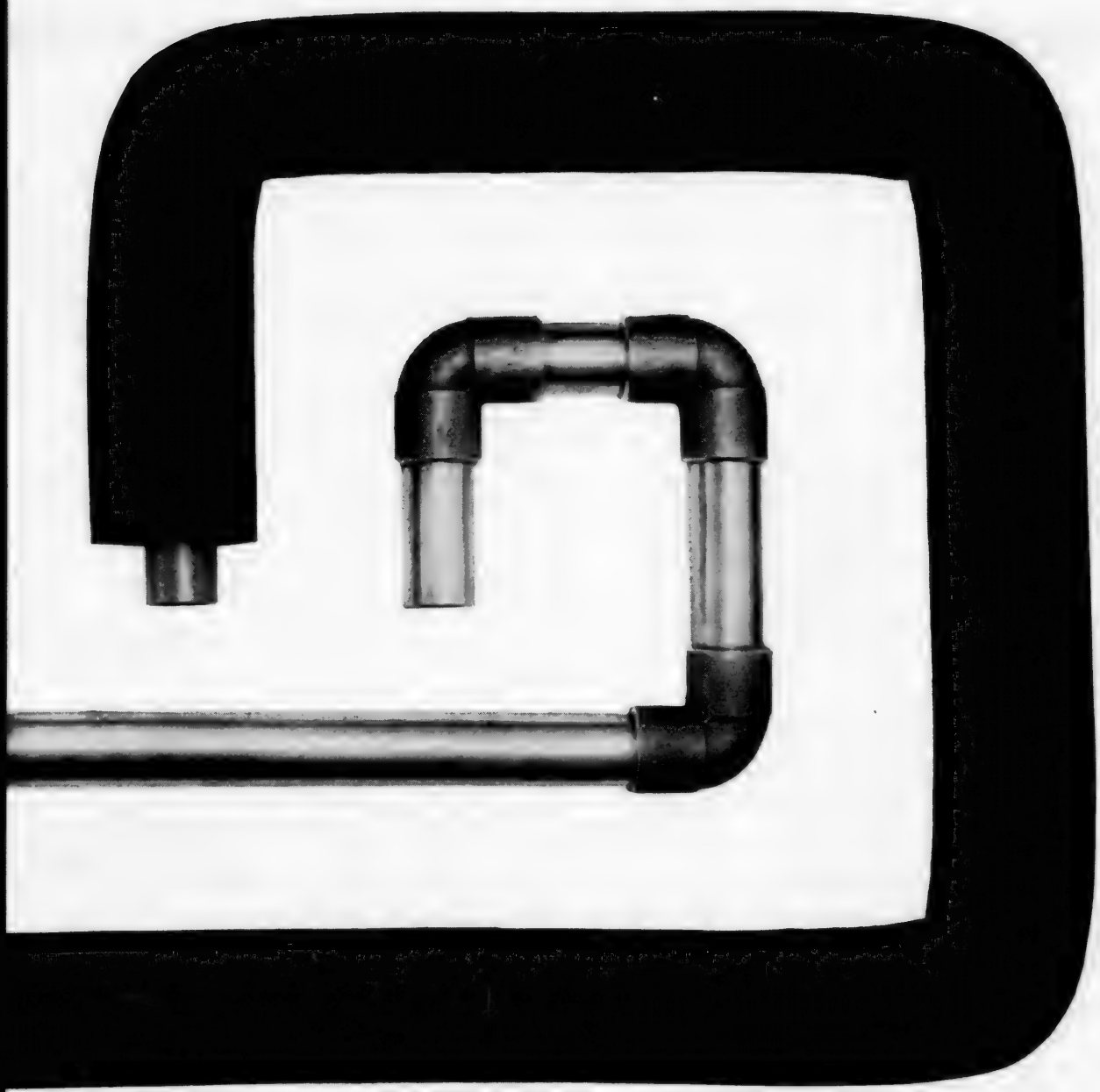
BUENSOD-STACEY

BUENSOD-STACEY CORP. • MANUFACTURED PRODUCTS DIVISION

45 West 18th Street, New York 11, N. Y. • A subsidiary of Aeronca Manufacturing Corporation



J-M Aerotube...a flexible, anti-sweat insulation designed for quick installation on bent tubing!

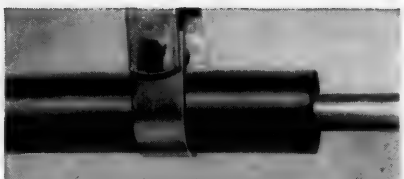


Now you can end the problem of pipe condensation on any indoor line quickly, easily and economically. With Johns-Manville Aerotube® even the most complex bend is a snap to insulate.

Aerotube is a flexible, foamed-plastic pipe insulation for use at temperatures from 32F to 220F. Its closed-cell structure prevents the passage of moisture under normal design conditions on indoor lines.

Because Aerotube is a flexible product (you can actually tie it in knots), it permits unique installation economies. The six-foot lengths go on quickly and easily. On new installations, simply slide Aerotube over tubing or pipes. For existing installations just slit Aerotube, snap it on and cement joints. That's all. Field reports show that installation costs can actually be cut in half.

If you have a condensation problem on heating, plumbing or air conditioning service lines, Aerotube can solve it. For full details, write to J. B. Jobe, Vice President, Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.



ALSO AVAILABLE...
A RIGID AEROTUBE

For compression-free insulation at pipe supports or for underground use, J-M's rigid Aerotube is recommended.

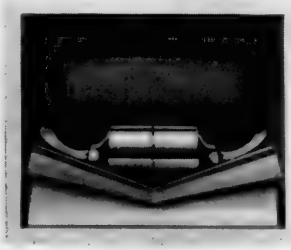
JOHNS-MANVILLE

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

JOHNS MANVILLE JM PRODUCTS

A REPORT FROM TRANE:

AN ADVANCED NEW LINE OF AIRFOIL FANS



TRANE announces a completely new line of Airfoil Fans. It is a new and advanced line—that provides quiet operation, high efficiency and uniform air delivery.

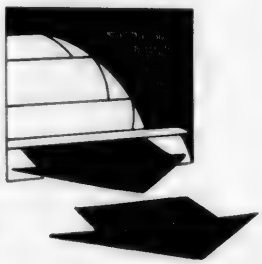
There's a TRANE Airfoil Fan for virtually every application—for comfort heating, ventilating or air conditioning—for higher pressures of Class III applications—for high or low pressure industrial process systems. This new line is available in a complete size range of Class I, Class II and Class III—Class I and II from 24″ to 89″; Class III from 24″ to 73″. Units have 88 to 91 per cent total efficiency rating.

Extensive research was done on every component of the new TRANE Fan. Countless tests were run. New manufacturing processes were developed to duplicate the exact contours of precision-built test models. Result: A fan that brings improved performance to air moving equipment.

EXCLUSIVE AIR CUTOFF

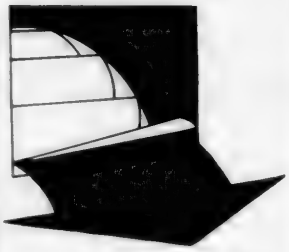
In developing this new line of Airfoil Fans, a design feature of major importance is the new type of air cutoff. The sloping rolled design of this cutoff helps create a more uniform flow of discharge air and reduces recirculation of air between the housing sides and fan wheel for quieter, more efficient fan operation.

OLD STYLE CUTOFF



With standard cutoff parallel to fan blades, definite impact results as air leaves the full width of blade, hits the full width of cutoff. This non-uniform air discharge sets up an objectionable sound that repeats at blade frequency.

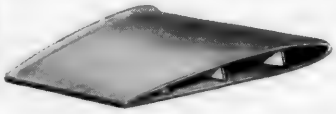
NEW TRANE CUTOFF



The sloping rolled cutoff peels the air off fan blade edges; air from the inlet end of each blade contacts highest point of the sloping cutoff. It intercepts the air along each point on the blade edge. As the last of the blade edge passes the lowest point of the cutoff, air from the inlet end of the next blade is already contacting the high point of the cutoff. The result is a continuous, smooth deflection of the air that is exceptionally quiet, with no "thumping."

ENTIRELY NEW BLADE DESIGN DEVELOPED

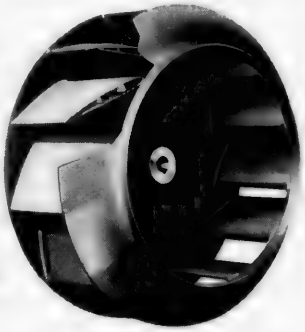
Over a hundred different types of airfoil blade shapes were developed and tested. These included blades in a wide variety of sizes and shapes—some with camber and some without.



This new TRANE Airfoil Blade has a very slight camber and a blade thickness that is 12 per cent of the blade's chord. This relatively thick blade contributes to the higher fan efficiency.

AIRFOIL WHEEL WITH 12 BLADES

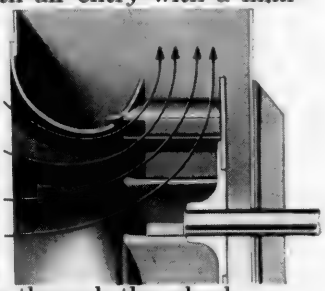
Integrated with the blade design was the development of the Airfoil Wheel and determination of the optimum number and angle of blades within the wheel. Wheels with various numbers of blades were tested. When 12 blades were used, it was found that the wheel operated most quietly and efficiently. It was also found that the sound generated by the 12-blade wheel was of a higher frequency and could be more easily attenuated.



The structural design of the wheel was proved in stress analysis tests. Wheels were run well above maximum design speeds without damage.

INLET CONE AND WHEEL RIM DESIGN ELIMINATE POWER-WASTING EDDIES

The inlet cone and wheel rim were designed and developed to work together. The design of the inlet cone permits smooth air entry with a minimum of shock and turbulence. Power-wasting eddies are eliminated.



The wheel rim reduces turbulence in the entering air as it leaves the inlet cone. By matching the contour of the inlet cone, the design of the wheel rim assures smooth, uniform air flow through the wheel.

NEW MANUFACTURING PROCESSES DEVELOPED

New manufacturing processes were developed for the TRANE Airfoil Fan to assure precise accuracy.

Each blade is manufactured from a single steel plate which is formed around a die with the trailing edge electrically welded and ground smooth. This precision die-forming and grinding results in an unusually smooth blade that is duplicated exactly and consistently time-after-time.

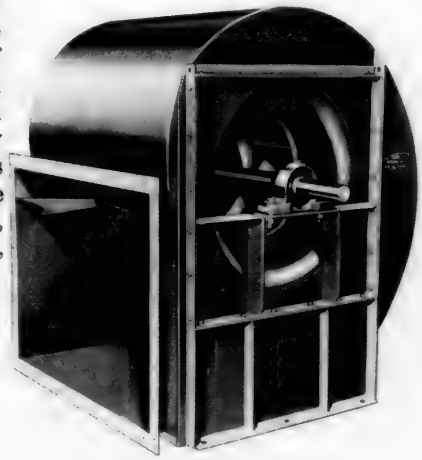
The 12 die-formed blades are continuously welded to a formed side rim and hub plate. Rigid fixtures hold components in precise position and a backstep welding procedure is used to prevent distortion and to assure close dimensional tolerances. The finished assembly is then mounted on a solid steel shaft and electronically balanced. The result is an unusually smooth-running, durable wheel.

As a result of advanced TRANE development and engineering, the new Airfoil Fans are exceptionally quiet in operation and are sturdily built to provide long life, trouble-free operation.

ACCURATELY RATED

All TRANE Airfoil Fans are accurately rated, carry the AMCA Certified Rating Seal.

WANT MORE FACTS on the new line of TRANE Airfoil Fans? Just call your nearby TRANE Sales Office—or write to TRANE, La Crosse, Wisconsin.



For any air condition, turn to

TRANE

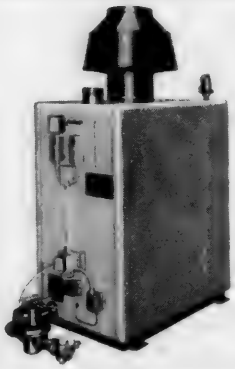
Manufacturing engineers of air conditioning, heating, ventilating and heat transfer equipment

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. PLANT, SCRANTON, PA. • CLARKSVILLE MFG. PLANT, CLARKSVILLE, TENN. • SALT LAKE MFG. PLANT, SALT LAKE CITY, UTAH • TRANE COMPANY OF CANADA, LIMITED TORONTO • 101 U.S. AND 20 CANADIAN OFFICES

BRYAN BUILDS a boiler for every purpose

Below are shown four basic Bryan Series. Whether you are designing a new school, hospital, office building, motel, or apartment house, one of these (oil or gas fired) will give your client Bryan Copper Tube flexibility, durability and economy.

Meet requirements of A.S.M.E. Code. Gas-fired models A.G.A. Approved.

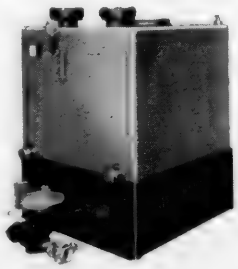


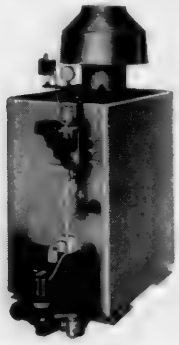
Domestic Heating

BOILERS 9 sizes from 75,000 Btu to 600,000 Btu output. Oil and gas burners are factory installed. Factory wiring is optional. Smaller models available as completely packaged units, with hot water circulation equipment installed.

Commercial Heating

BOILERS 8 sizes from 720,000 Btu to 1,800,000 Btu output, most sizes completely assembled, packaged units, for steam and hot water radiation. Suitable for most schools, churches, apartment houses, office and industrial buildings.



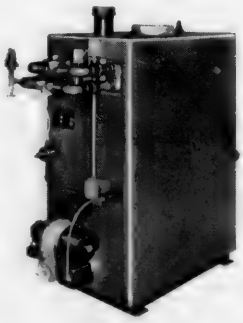


High Pressure

BOILERS Sizes up to 50 hp and up to 125 lb. mwp. Noted for providing steam on short notice and at high efficiency. Particularly fine for hospitals, dry cleaning plants, laundries, dairies, tire repair shops, food processors and others.

Water Heating

BOILERS Sizes from 100,000 Btu to 1,800,000 Btu output. By *indirect* heating, two or more water temperatures can be delivered simultaneously. Used for hospitals, restaurants, laundries, hotels, swimming pools and industry.

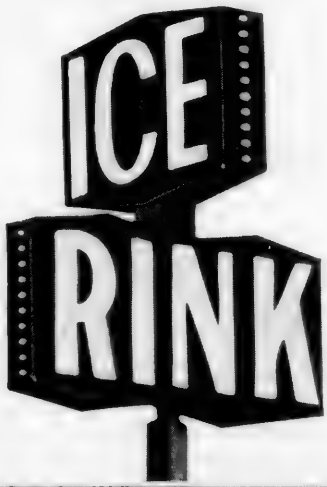


BRYAN STEAM CORPORATION

Bryan Boilers COPPER TUBE

CHILI PIKE, PERU, INDIANA

California Rink Built with STEEL PIPE



Glacier Falls Ice Rink, in Anaheim, California, is another example of the nation-wide boom in skating. It's a fast-growing trend that's slicing a big share of the recreation business for the new ice rinks now being built in unprecedented numbers. And more and more of them are being built with steel pipe, such as Bethlehem Ammonoduct.

WHY STEEL PIPE? Steel pipe *costs less* than any other ferrous piping material. And it's *less costly to install.* It can be *bent cold* without danger of fracture, and is available in *double-random lengths,* cutting down on field welds. The coupon below will bring you the full story.

Pipe your next rink with steel—steel pipe Made in U.S.A.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Steel

for strength
. . . economy
. . . versatility

Glacier Falls Ice Arena, Inc., built this 85 by 180-ft rink with Bethlehem's Ammonoduct steel pipe. Refrigeration was designed by William Webster, and contracted to George Baney. Kohlenberger Engineering Corporation engineered the rink, with the pipe supplied in 40-ft lengths by Monarch Piping and Engineering Company. Marshall Garrett manages the rink, with his assistant, Willie Kall.

SEND TO: COMMITTEE OF STEEL PIPE PRODUCERS
AMERICAN IRON AND STEEL INSTITUTE
150 E. 42ND ST., NEW YORK 17, N. Y.

Gentlemen: Please send me your new booklet: Steel Pipe in Ice Skating—A New Approach to an Old Sport.

Name _____

Company _____

Address _____

City _____ *Zone* ____ *State* _____

Four Seasons Climate Controlled!

with

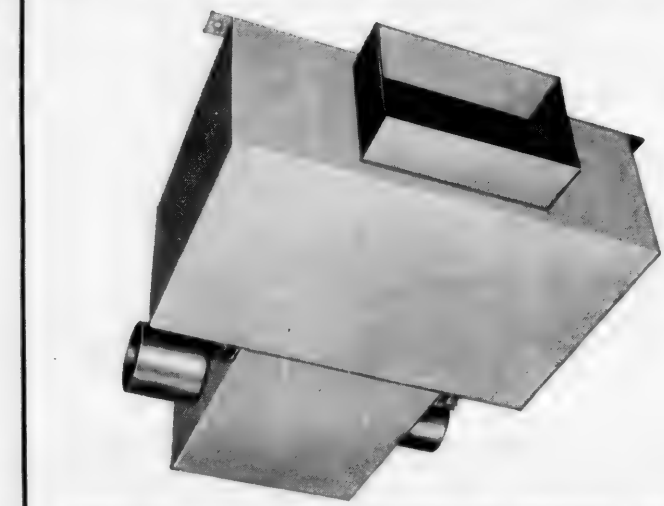
AGITAIR®
CONSTANT VOLUME
MIXING BOXES

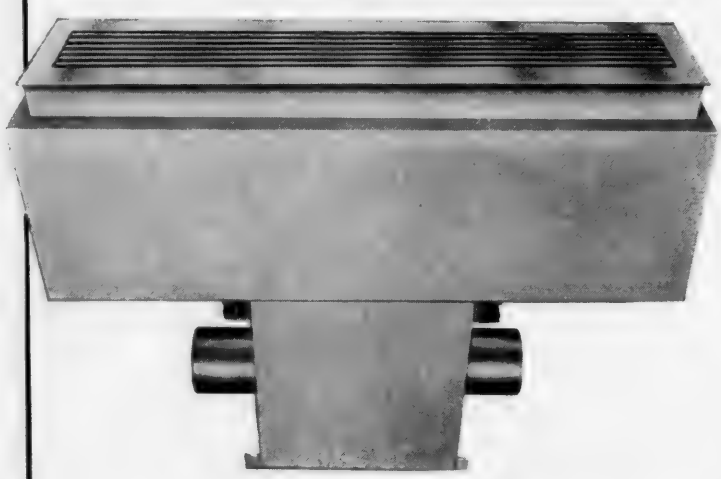
When AGITAIR high velocity mixing boxes are installed, you can be sure that required indoor climate conditions are constantly maintained regardless of sudden changes in outdoor temperatures.

These units designed and developed by Air Devices Inc. engineers, incorporate every desirable element necessary to assure perfect air mixing—constant air volume control—noise attenuation and air distribution.

One motor operates inlet valves—AGITROL volume regulator guarantees constant volume control within five percent of design—extremely low sound ratings. For noiseless, draftless distribution of the conditioned air from these AGITAIR units there is a complete line of AGITAIR genuine diffusers and grilles that can be employed to meet any job requirement.

Technical Catalog HV-100 contains complete performance data and dimensions on all AGITAIR mixing boxes. Write for your copy today.





featuring... One motor—no linkages. Aluminum inlet valves driven directly—instantaneous response...no lost motion...no backlash. Unique AGITROL valve (constant volume regulator) actuated solely by the supply air. Both mixing and attenuation chambers fabricated of galvanized or galvannealed steel...sealed to prevent air leakage. Split fabrication of attenuation chamber permits dimension adaptation to meet most space limitations.

AIR DEVICES INC. 185 MADISON AVENUE • NEW YORK 16, N. Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

PRESCRIPTION!

RX for precision-drawn, trouble-free copper capillary and restrictor tube: consult a Small Tube Specialist. New product: capped-and-certified restrictor tubing with certification covering 100% testing of tube to meet flow specifications. After testing, lengths of certified tubing are capped at both ends (center above) with a heat-sealed plastic. Kensico produces capped-and-certified copper tubing in a broad range of sizes from a minimum of 0.072″ OD by 0.026″ ID to a maximum of 0.172″ OD by 0.115″ ID.

Over the years, Kensico has also built a healthy reputation for producing highest quality copper tubing for general air conditioning and refrigeration use. Painstakingly produced to customer's exact specifications, it is available in coils and straight lengths, with a variety of end treatments as shown. Call Kensico today. Find out for yourself how well deserved is Kensico's reputation as a Small Tube Specialist. Air Flow Engineering Charts upon request. Write to KT-61, Kensico Tube Company Division, Mt. Kisco, N. Y.

Kensico Tube
COMPANY DIVISION
Robinson Technical Products, Inc. • MOUNT KISCO, NEW YORK

Kensico Products are also available through Warehouse Distributors and Sales Representatives in Cambridge, Mass.; Middlebury, Conn.; Buffalo, N. Y.; Lindenhurst, N. Y.; Goshen, N. Y.; Roselle, N. J.; Philadelphia, Pa.; Flourtown, Pa.; Pittsburgh, Pa.; Cleveland, Ohio; Chicago, Ill.; St. Louis, Mo.; Milwaukee, Wisc.; Durham, N. C.; Dallas, Texas.

FIRST PRE-PACKAGED

electric storage water heater for commercial, industrial and institutional use.

The new P-KW is the first electric storage water heater to be offered as a standard package unit. It is shipped fully wired, insulated and factory tested. It requires only electrical and water connections to place in operation.

The new unit is equipped with immersion heater, control thermostat, magnetic contactors, circuit breaker, panel control box, ASME temperature and pressure relief valves, thermometer, pressure gauge, metal jacketed insulation, and integral support skids.

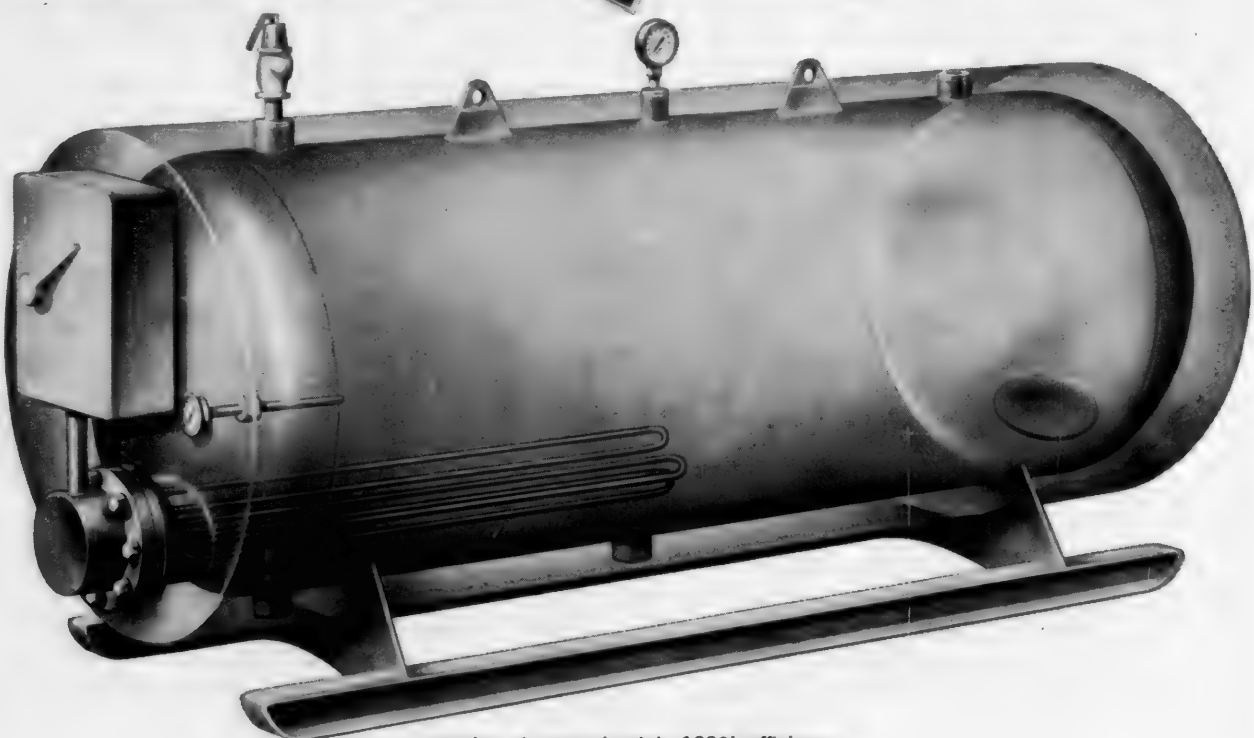
Made by P-K on a custom basis for many years, P-KW Electric Storage Water Heaters are designed and fabricated in accordance with the ASME Code and Federal, State and local regulations.

Components that comprise the electrical system, including wiring, meet the requirements of Nema standards and the National Electrical Code.

The immersion heating elements are operated approximately 10 per cent below their voltage capacity—assuring long, trouble-free service. The thermal conversion approximates 100 per cent efficiency.

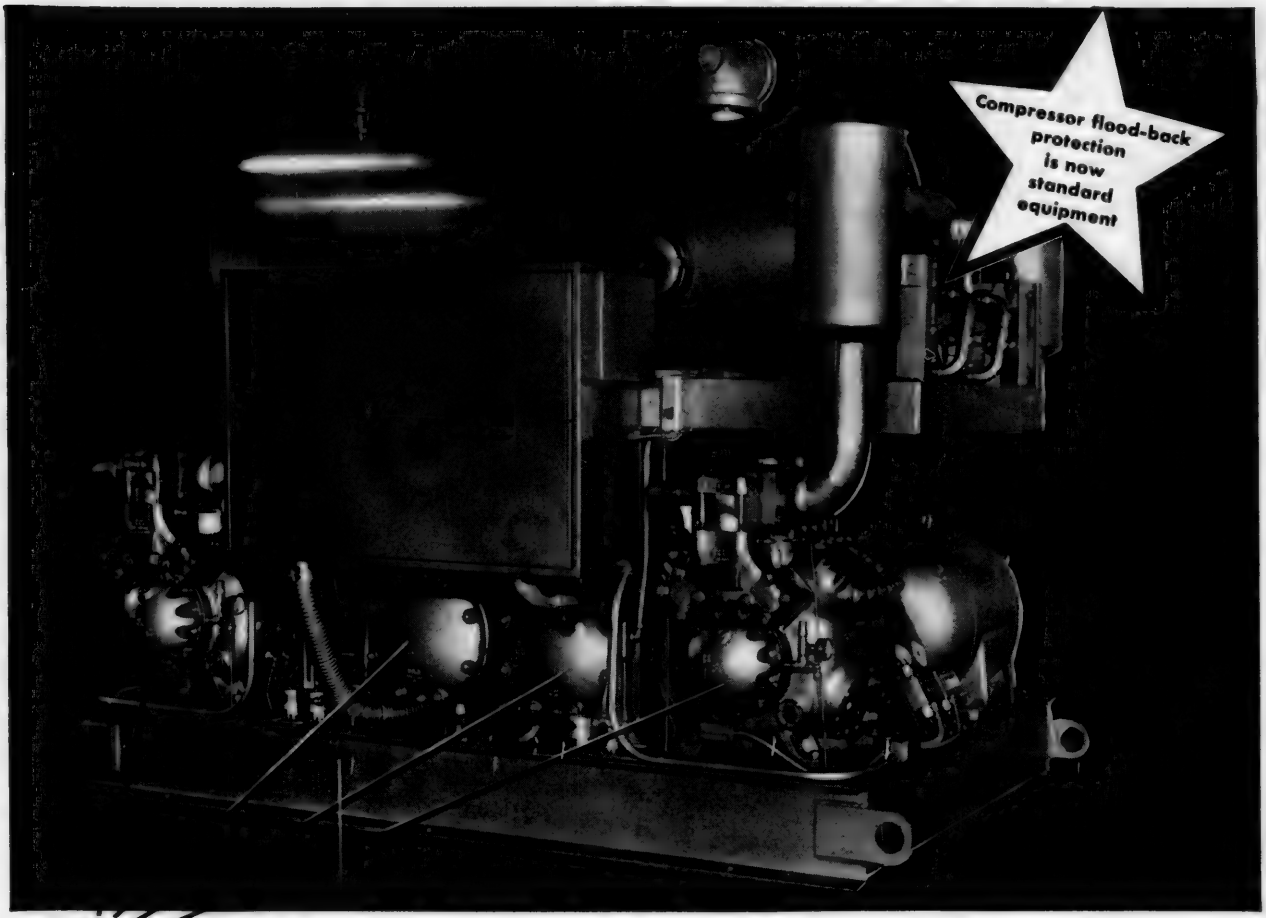
Pre-packaged P-KW water heaters can be selected for three working pressures – 100, 125, and 150 psi.

WRITE FOR CATALOG NO. P-KW-1: contains diagrams, specifications, complete engineering and performance data. Address your request to: The Patterson-Kelley Co., Inc., 211 Morgan Avenue, East Strondsburg, Pa.



- operates at approximately 100% efficiency
- storage capacities from 284 to 1,300 gallons
- recovery capacities from 41 to 410 gph
- horizontal or vertical design
- safe, silent, automatic

Patterson Kelley



2 COMPLETE CIRCUITS WITH AUTOMATIC LEAD-LAG

The B&G Package Liquid Cooler is now available *with two complete refrigeration circuits*...dual compressors, dual condensers and a single evaporator! It has a capacity reduction of 25%—in stages of 100, 75, 50 and 25%. All operative and safety controls are installed and pre-wired.

An outstanding feature is the automatic lead-lag selector switch. In operation, No. 1 motor and compressor handle the load until cooling requirements are satisfied or until No. 2 unit needs to be called into use.

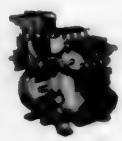
On the next starting, No. 2 unit picks up the load. *Therefore each motor and compressor gets equal usage!* This dual arrangement is also valuable because it provides stand-by protection in case of emergencies.

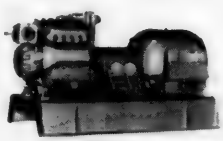
Remember, too, that all major parts of B&G "package" units are manufactured and guaranteed by Bell & Gossett Company...*one* responsibility for satisfactory operation.

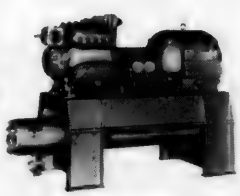
Send for complete engineering data on B&G Air Conditioning and Refrigeration equipment.

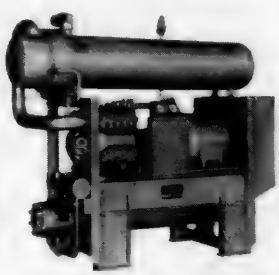
M-PAK
MODULAR PACKAGES

M-Pak units make it possible to build up from factory stock a comprehensive line of motor compressors, condensing units and package liquid coolers. Starting with five basic compressors, other stocked components are added to make up the unit desired. M-Pak Modular Packages are available for prompt delivery in capacities from 7½ to 150 tons.


B&G Compressor


B&G Motor Compressor


B&G Condensing Unit


B&G Package Liquid Cooler

BELL & GOSSETT
COMPANY
Dept. RGX-4 Morton Grove, Ill.
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

MARSH PACKLESS RADIATOR VALVES

WHEEL HANDLE

GRADUATED

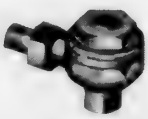
LOCK AND SHIELD

ANGLE PATTERN

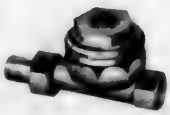
GLOBE PATTERN

CORNER PATTERN (Sectional Below)

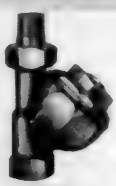
MARSH THERMOSTATIC RADIATOR TRAPS



ANGLE PATTERN

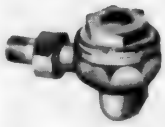


STRAIGHTWAY PATTERN

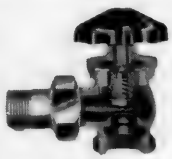


VERTICAL PATTERN

LEFT HAND CORNER PATTERN



RIGHT HAND CORNER PATTERN



CUT OPEN VALVE

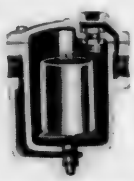
F&T TRAPS

No. 12, REPRESENTATIVE OF WIDE LINE

VENTS

No. 5 VENT, ONE OF MANY

BUCKET TRAPS

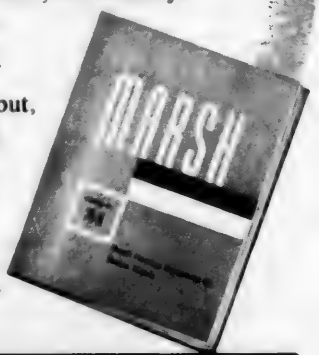


No. 500 INVERTED BUCKET TRAP

All the best of their kind!

You probably have made certain Marsh products your standbys without realizing there are a lot more of them just as superlative as the ones you like so well.

Make the acquaintance of some of them here, but, better still—***Ask for this Marsh Catalog!***



MARSH INSTRUMENT COMPANY
Dept. U, Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St. Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.
Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

MARSH
Heating Specialties since 1865

GAUGES AND THERMOMETERS

THER-ALTI-METER (Square and Round)

HOT WATER BOILER THERMOMETER

PIPING THERMOMETER Four Ranges (Also remote reading)

DUCT THERMOMETER Three Ranges (Also remote reading)

Governair

COMPLETELY SELF-CONTAINED

AIR COOLED

PACKAGE UNIT TYPE SCAC

GOVERNAIR'S SCAC is available in six basic models from 10 through 40 ton capacities. Typical GOVERNAIR flexibility has been maintained with a choice of 4, 5, or 6 row cooling coils offered to meet all capacity requirements. Roof mounting has been considered in the Low-Silhouette arrangement.

The basic one-piece cooling unit is housed in a rugged weatherized cabinet and mounted on rails. It is completely wired, charged and tested at the factory. Demountable and remote arrangements are available, and accessories include choice of filters, face and by-pass dampers, reduced voltage starters, Low Ambient Control, and the Gas Fired Furnace Section.

YEAR-'ROUND AIR CONDITIONING is accomplished by the use of the gas-fired furnace section. This accessory consists of a complete and unaltered gas-fired duct furnace housed in a Weatherized Cabinet with an integral by-pass damper arrangement. Refrigerated air may completely by-pass the furnace, while any desired amount of air is diverted through the furnace during the heating cycle.

FOR AN INFORMATIVE FOLDER, CONTACT YOUR LOCAL GOVERNAIR REPRESENTATIVE OR WRITE

GOVERNAIR

ONE STOP SHOPPING FOR AND AIR CONDITIONING

SARCO RADIATOR TRAPS, TYPE H

Sarco Type H Radiator Trap, angle pattern

Standard traps for all types of two-pipe steam heating systems. Suitable for pressures from highest vacuum to 25 psi. Require no adjustment in service. Removes air and condensate from radiators or convectors rapidly, completely, without steam waste or noise. Vertical traps are designed for bottom connected convectors to facilitate installation and cleaning.
Bulletin No. 155

SARCO PIPELINE STRAINERS

Type D (semi-steel) flanged, 125 and 250 psi

Types AT (semi-steel) 250 psi and BT (brass) 250 psi

Type CT (cast steel) 600 psi

For condensate, steam, water, oil, air, gas, and other piped fluids

Effective, inexpensive insurance against costly shutdowns and heavy repair bills. Installed ahead of the equipment, they protect the working parts of temperature and pressure regulators, steam traps, pumps, meters, burners, compressed air equipment, hydraulic systems, lubricators, and nozzles.

Standard screen used in Sarco strainers is constructed to prevent particles from by-passing the screen at the ends.

Rigid construction prevents rupture of screen when sediment creates abnormal pressure differentials. No weave-crevices to trap particles, and, therefore, more readily cleared by the use of the blow-down connection.
Bulletin No. 1210

SARCO BALANCING FITTINGS

Type 10 Series Angle Union Pattern Thread Type

Type 40 Series Straightway Union Pattern Sweat Type

Type 50 Series Straightway Screwed Pattern

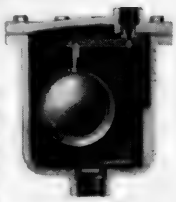
Type 60 Series Straightway Soldered Pattern

For balancing branch or circuit resistance of radiators, convectors, heating or cooling coils, unit heaters, and other heat transfer surfaces employing hot or chilled water. Unique solid segment stem assures linear straight line flow not obtainable with butterfly stems. Maximum water pressure 200 psi cold liquid—non-shock; 175 psi, 250°F. temperatures.

Available either in standard construction or with integral manual air vent in 3 standard patterns: angle union, straightway union, and straightway female connection. Both screwed end and sweat types. Twenty-six different patterns and sizes.

Bulletin No. 225

SARCO HIGH CAPACITY AIR ELIMINATORS FOR WATER

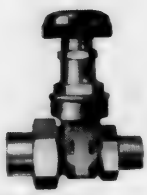


Type 13W For Water Heating and Cooling Systems

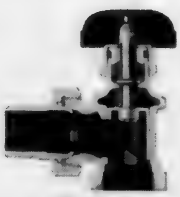
Type 13W and 13WH vent air from radiant or hot water heating systems, high pressure, high temperature hot water lines, chilled and condenser water lines in air conditioning installations, and process liquid lines — eliminate air pockets that prevent or retard circulation. Float-controlled discharge valve vents air rapidly through large orifice. Float action prevents escape of fluid.
Maximum pressure ratings: No. 13W — 150 psi; No. 13 WH — 300 psi.
Bulletin No. 170

SARCO VALVES FOR WATER

No. 37 Quick-Opening

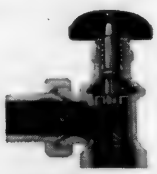


No. 129 Convector and Radiator Gate



No. 157 Sleeve Type

No. 127 Convector and Radiator Gate



No. 167 Sleeve Type

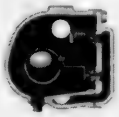
Bulletin No. 225

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.

QUALITY HOT WATER, STEAM, SPECIALTIES...FROM SARCO

SARCO FLOAT-THERMOSTATIC STEAM TRAPS FOR 0-15 PSI



Type FT ¾", 1", and 1¼"
Bodies and covers of semi-steel (rated at 125 psi). Stainless steel valve and mechanism.

Type FTL 1½" and 2"
Bodies and covers of semi-steel (rated at 125 psi). Stainless steel valve seats. Renewable bronze valve heads.

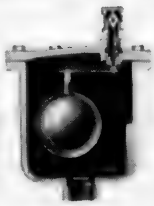
Sarco Float-Thermostatic steam traps discharge condensate at steam temperatures continuously and without shock. Air binding impossible — separate thermostatic air vents remove automatically and continuously all air and incondensable gases reaching the trap. Balanced pressure vent self-adjusts to all operating pressures, and location above condensate level permits discharge of air and gases reaching trap after start up. Do not require adjustment when pressures change.
Bulletins No. 450 & 455

SARCO AIR ELIMINATORS FOR STEAM

For Low Pressure Steam Heating Systems

Type 6, 6T, and 13-S Air Eliminators vent air from radiators and piping rapidly and completely. Float valve design prevents spillage. Check valve prevents air return under vacuum.

Types 6 and 6T have brass heads and seats, cast iron body. Body of 13-S is semi-steel with stainless steel head and seat. Pressures to 15 psi.
Bulletin No. 170



Type 13-S Air Eliminator

Type 6 Air Eliminator

SARCO DOMESTIC WATER BLENDERS, TYPE DB

Maximum Working Pressure, 125 psi

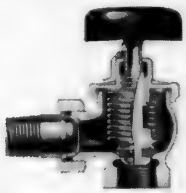
Designed for use with submerged heating coils in residence or apartment heating boilers and external submerged coil heaters piped to heating boilers, where the pressures on cold and hot water supplies are balanced. Because the water in the boiler varies in temperature with the steam pressure carried, or the heating load, service hot water may be delivered to the fixtures at boiler water temperature.

The DB blender prevents this by automatically adding enough cold water to the hot discharge from the heater coil to maintain the desired moderate water temperatures to the fixtures.

Adjustable between 120°F. and 160°F. Any other range, covering 40°F. can be supplied at extra charge.
Bulletin No. 800

SARCO RADIATOR VALVES FOR STEAM

Gate Valve, Reinforced Packless Bonnet
129 — Double wedge disc convector gate valve with female union inlet, male threaded outlet. Max. pressure — 60 psi.



Bellows Packless Radiator Valve
45A — Valve stem positively sealed by flexible bellows of heavy-wall, helically-corrugated, bronze tubing. Modulating, non-modulating, and lock-shield types, angle and straightway patterns. Max. pressure — 25 psi.

Gate Valve
127 — Double wedge disc gate valve, female union inlet, male threaded outlet. Can be repacked under pressure. Available in a variety of connections. Max. pressure — 125 psi.

Reinforced Packless Bonnet
1141 — Vapor-tight stem, quick-opening, non-rising, with renewable composition cone disc. Max. pressure — 60 psi.

Bulletin No. 225

Plus . . . SARCOTHERM TEMPERATURE CONTROL SYSTEMS

These outdoor weather-compensated heating control systems are custom planned for schools, office buildings, hospitals, apartment buildings, developments.

- Maintain uniform inside temperature by automatically adjusting flow of hot water or steam to compensate for changes in outdoor temperature and room load demand.
- Insure low installed cost . . . with fewer controls, less wiring.
- Special drawings furnished for each job. On-the-job assistance from Sarcotherm's field engineers.

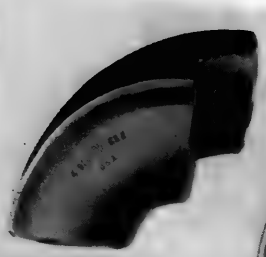
ALSO AVAILABLE: steam traps, Sarcofin and Sarcopak radiation, access boxes, temperature controls, vacuum and condensate pumps, and thermometers.

5924

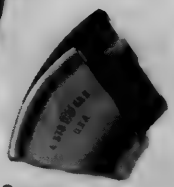
SARCOTHERM

SARCOTHERM CONTROLS, INC.
AN AFFILIATE OF SARCO COMPANY, INC.
548 MADISON AVENUE, NEW YORK 22, N. Y.
CONTROL SYSTEMS FOR STEAM, HOT WATER AND RADIANT HEATING

Now



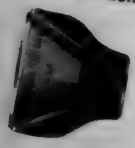
Compact 90° Elbow versus conventional long radius elbow*



Compact 45° Elbow versus conventional 45° elbow†

Compact Straight Tee versus conventional

Compact Reducing Tee versus conventional



Compact Concentric Reducer versus conventional

Compact Eccentric Reducer versus conventional

Compact Welding Cap versus conventional

Note these actual photos showing dimensional differences between Compact Fittings and corresponding conventional fittings.

*The Compact 90° elbow is contrasted with a conventional long radius elbow which is by far the most commonly used type. Of course the dimensions of the Compact 90° elbow are the same as those of regular short radius Taylor Forge WeldELLS.

†The 45° conventional elbow has heretofore been obtainable only in the long radius pattern shown in the comparison.

Tests prove rugged strength

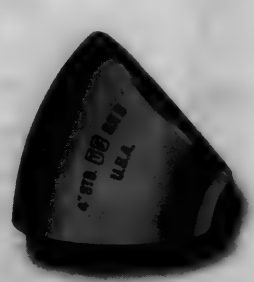
Photograph shows a test that has proved the rugged strength of Compact Line Fittings. The test unit was fabricated from 4" and 6" Standard Thickness (Schedule 40) Grade B pipe and includes a 6" x 6" x 6" Tee, a 6" 90° Elbow, a 6" 45° Elbow and a 6" x 4" Concentric Reducer.

In testing, a mean pressure of 875 psig (five times WOG rating) was established as basic pressure. Cyclic pressure variation was from 50% under to 50% over this pressure—in other words, from 437 psig to 1312 psig. The assembly was then subjected to 36,500 of these pressure cycles—the equivalent of one cycle per day for *100 years!*

Upon completion of the cyclic testing, the unit was hydrostatically burst, the break occurring, as it theoretically should, in the crotch of the tee and extending into the adjacent run and branch pipes. Moreover, the unit had to be brought to a pressure of 5200 psig before bursting, yet the theoretical bursting pressure of 6" pipe is only 5080 psig. After 36,500 pressure cycles this result is rather startling.

90° ELBOWS

45° ELBOWS



STRAIGHT TEES

it's the New TAYLOR FORGE

there IS a way

to cut heating | cooling piping costs and still have a piping job you can be proud of

Yes, the new Taylor Forge Compact Line of welding fittings really does reduce piping costs. First, because the simplified designs and reduced dimensions permit major manufacturing economies. Second, because all other incidental costs—shipping, storage, trucking, on-the-job handling—are also less than with conventional fittings.

Take the 4″ size for example: A "set" of Compact Fittings consisting of a 90° and 45° elbow, straight tee, cap, 4″ x 2″ tee, 4″ x 2″ concentric reducer and 4″ x 2″ eccentric reducer exactly as illustrated here, weighs little more than half as much as corresponding conventional fittings. And remember, this weight savings is purely the result of designing and dimensioning functionally for economy.

Taylor Forge Compact Line Fittings give you a piping job you can be proud of, too. Proud of its trim functional appearance. Proud of its rugged strength and complete dependability—well supported by the test described on the opposite page.

Compact Line Fittings are of seamless construction using Grade B carbon steel. The line includes 90° and 45° elbows, straight and reducing tees, concentric and eccentric reducers and caps in sizes 2″, 2½″, 3″, 4″, 5″ and 6″; reducing tees and reducers in intermediate iron pipe sizes down to one-half of the nominal run or large end size. They are manufactured to the same high standards as other Taylor Forge products for piping and pressure vessel construction. All have complete stamped-in identification markings as shown. For protection, identification, and pleasing appearance, they are painted orange with non-toxic corrosion resistant paint.

American-made Welding Fittings

Designed and manufactured for utmost economy. No frills; just the solid value you would expect from **TAYLOR FORGE.**

TF

TRADITIONALLY DEPENDABLE

Compact line fittings are carried in stock by Taylor Forge Distributors in all important trading centers. The whole story is in Bulletin 619. *Ask for it.*

Taylor Forge & Pipe Works

General Offices and Works: P. O. Box 485, Chicago 90, Illinois

Plants: Carnegie, Pa.; Somerville, N.J.; Gary, Ind.; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada

District Sales Offices: New York, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Hamilton, Calgary, Montreal

REDUCING TEES	CONCENTRIC REDUCERS	ECCENTRIC REDUCERS	WELDING CAPS

COMPACT LINE of Welding Fittings

BUREAU OF CENSUS PROJECTIONS
INDICATE U. S. SCHOOL SYSTEMS
MAY HAVE TO ACCOMMODATE
65% MORE STUDENTS BY 1980.

Will this lead to . . .

365-day

Here's why provision for future air conditioning should be included in the plans for every new school

With almost every community in the country facing continuously increasing tax loads for new classrooms, the possibility of 12-month schools in the future cannot be discounted. Add to this that thousands of schools throughout the nation have summer sessions and that almost all of them are used for community and school-related activities, and the values of air conditioning become increasingly significant.

Nor can the benefits of air conditioning during the traditional school year be denied. The school building is cleaner, more comfortable, and more healthful. Absenteeism is lower. And *optimum* learning environment is established — pupil and teacher productivity is maximized.

Many communities already have built, or are building, air-conditioned schools. But others are not yet ready to take this step. The answer for these is to plan *today* for air conditioning *tomorrow*.

The cost of providing for future air conditioning is moderate. Modern unit ventilators now are available to accommodate air conditioning when it is added to the school in the future. Standard Barber-Colman unitized controls are your best choice for such installations. Unlike other types of controls,

PRODUCERS' COUNCIL

BARBER COLMAN

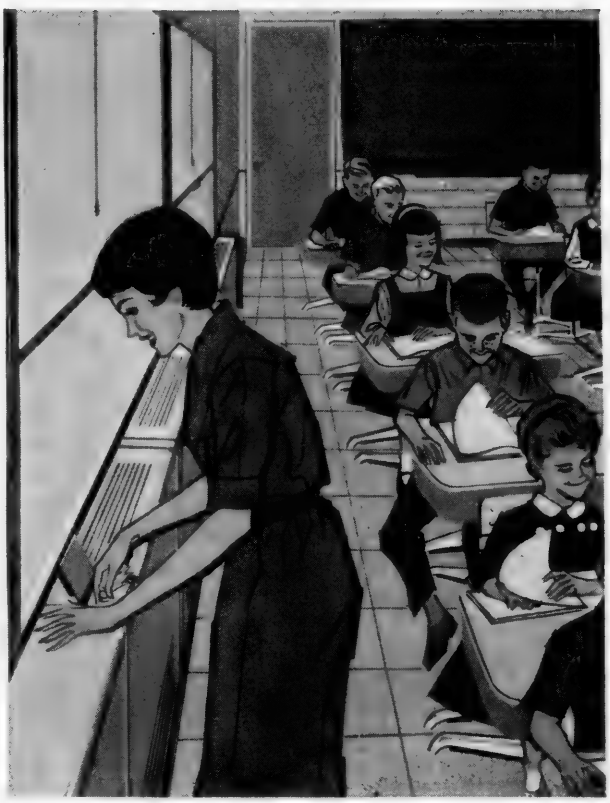
schools?

they do not need to be replaced when the air conditioning is installed, but can be easily and economically converted to handle it.

Schools are built to last for a long time. They must be planned with the future in mind — a future that promises to be an air-conditioned one.

Whatever part you may play in the planning and construction of new school buildings, it will pay you to thoroughly investigate unit ventilators and Barber-Colman controls designed to accommodate the economical addition of air conditioning at a later date.

For complete details, consult your local Barber-Colman Automatic Controls field office or write to the address below.



BARBER-COLMAN COMPANY

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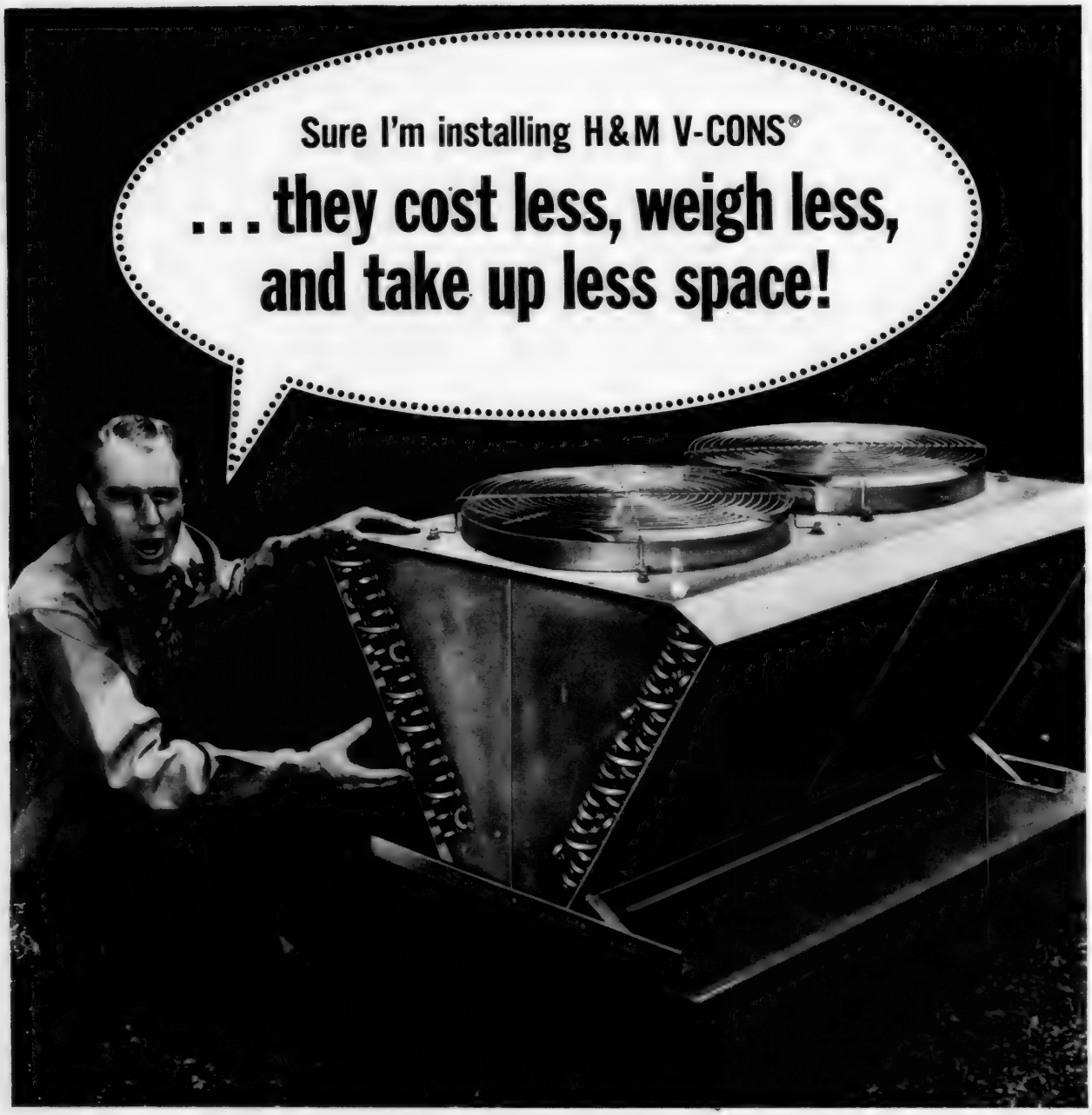

No wonder these Halstead & Mitchell V-Cons® are the hottest selling air-cooled condensers around. First off, they give full performance yet cost up to 15% less than comparable capacity condensers.

Second, they weigh about half as much because they are housed in light-weight, corrosion-resistant aluminum. The fan blades are aluminum, too. Thus, roof loading is much lower and rigging far easier.

Next, they combine the low height and quiet operation of vertical discharge condensers with the minimal space requirements of horizontal discharge units.

Currently available in 3, 5, 7½, and 10 ton sizes, these new units round out Halstead & Mitchell's line of vertical and horizontal discharge condensers of 3 to 100 ton capacity. All models feature H&M's exclusive Turbu-Flo fins, which improve heat transfer between refrigerant and air.

For more information, contact your wholesaler, or write for Bulletin VC-103. Halstead & Mitchell Co., Dept. B-11, Bessemer Bldg., Pittsburgh 22, Pa.

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BIG BURNERS

Outsells because it Excels

Models 1200 and 2000, firing range 6.00 to 12.00 gph and 10.00 to 20.00 gph respectively, are heavy-duty oil burners equipped with High Temperature Combustion Head for clean burning, intense fires in the higher ranges.

Electronic controls, factory mounted and wired, available for all models.

BIG in every way!...

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High gallonage U.S.-Carlin Oil Burners put you in line for the desirable No. 2 oil jobs in schools, apartments, churches, civic buildings, and non-residential structures of all kinds. These are the burners that enable you to meet "heavy oil" competition. Here's why: customer acceptance is established, service is quickly handled, replacement parts are readily available, fuel suppliers are plentiful, installation is fast—and profitable!

BIG PERFORMANCE

World-wide, U.S.-Carlin Oil Burners are recognized for performance that's always a step ahead. High efficiency—with economy—unmatched in the field of oil heating is the result of combining advanced design features with sound engineering principles.

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By every measure . . . strict adherence to rigid production standards, use of highest quality materials and components, precise attention to every detail . . . U.S.-Carlin Oil Burners represent big value that opens big profit opportunities.

Get all the facts on U.S.-Carlin Oil Burners today. Ask your heating wholesaler . . . or write us direct.

Model 2000 S-5, a genuine "Shell Head" oil burner with firing range from 7.00 to 12.00 gph, offers the ultimate in clean, complete combustion.

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OIL BURNERS
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POWER GAS BURNERS
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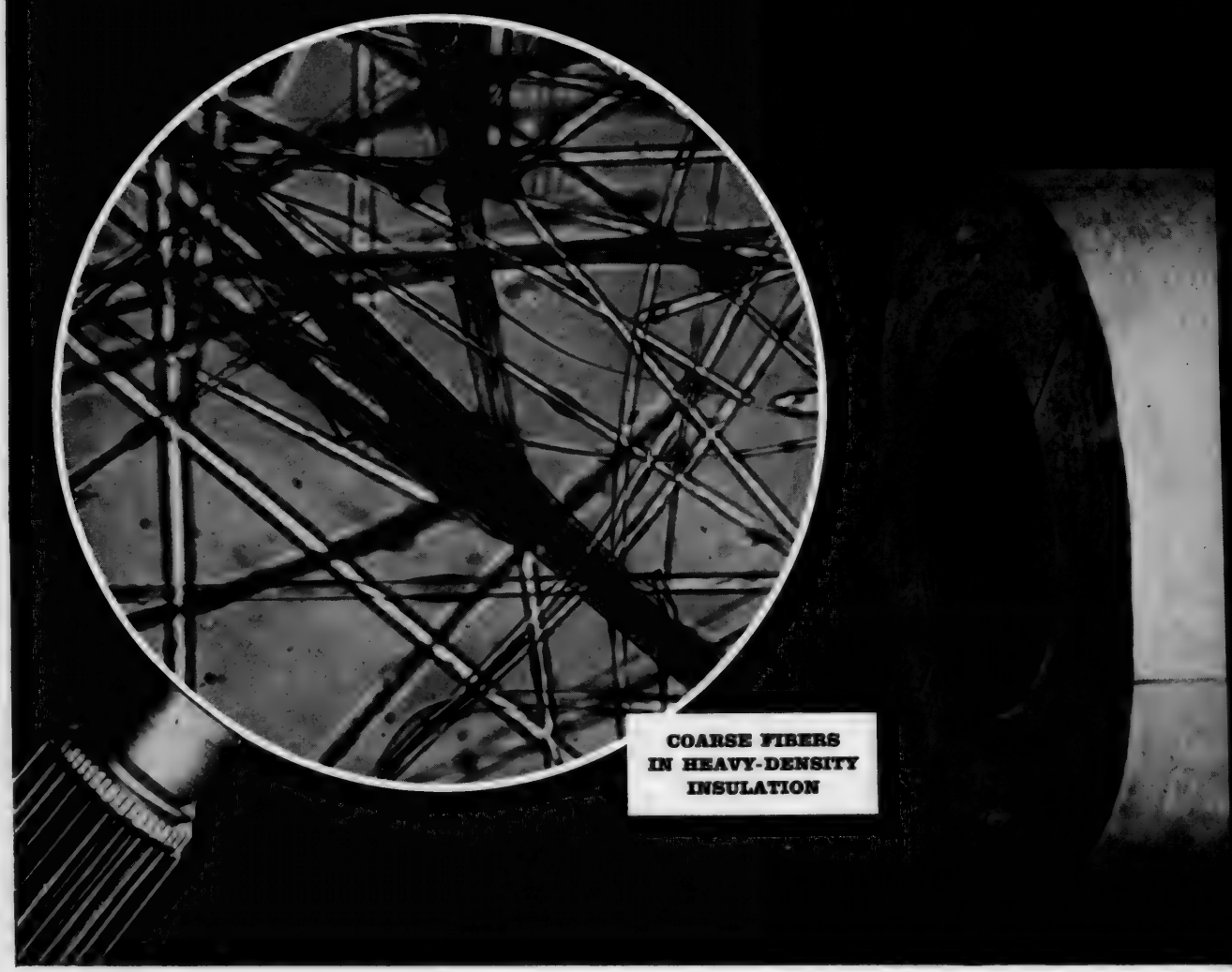
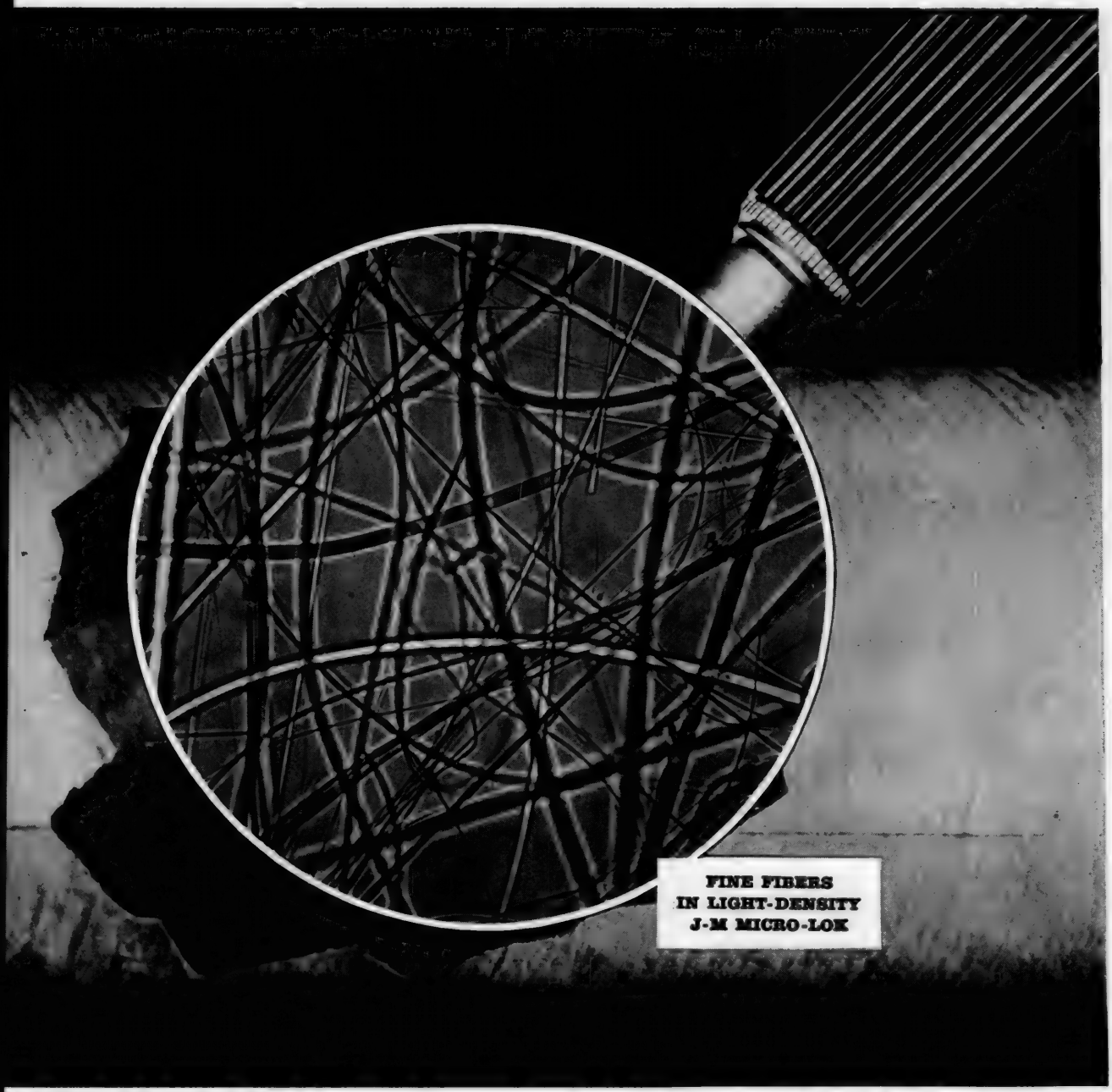
Model 1200N, firing range from 6.00 to 10.00 gph, is especially designed for efficient firing in boilers having narrow fire boxes, and low base boilers.

U.S.-Carlin Oil Burners are listed by Underwriters' Laboratories, Inc. and approved under U.S. Government Commercial Standard CS75-56 where applicable.

THE BIG DIFFERENCE IN PIPE INSULATIONS:



See why lighter density makes **J-M MICRO-LOK** most effective... most economical



Photomicrographs of glass fibers at 250x magnification

Micro-Lok pipe insulation is made of long, resilient, extremely fine glass fibers. This means that infinitely more and smaller air pockets are created than would be formed by coarse, more rigid fibers made by an old-fashioned process.

Thus, Johns-Manville Micro-Lok provides considerably more resistance to the passage of heat, yet its density is only about half that of pipe insulations made of coarse fibers.

Specifically, fine-fibered, light-density Micro-Lok has a k factor of .245 at 100F mean temperature — about 10% *lower* than coarse-fibered, heavy-density products.

Micro-Lok's superior resiliency also means that its surface can more readily absorb accidental blows without puncturing or ripping the vapor barrier jacket.

Micro-Lok is highly effective for temperatures from minus 120F to 370F. Made in all standard IP and CT sizes and wall thicknesses, Micro-Lok is available with a wide range of factory-applied jackets including canvas, general purpose and flame-resistant vapor barriers such as the new Flame-Bar. For details, write to J. B. Jobe, Vice-President, Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.

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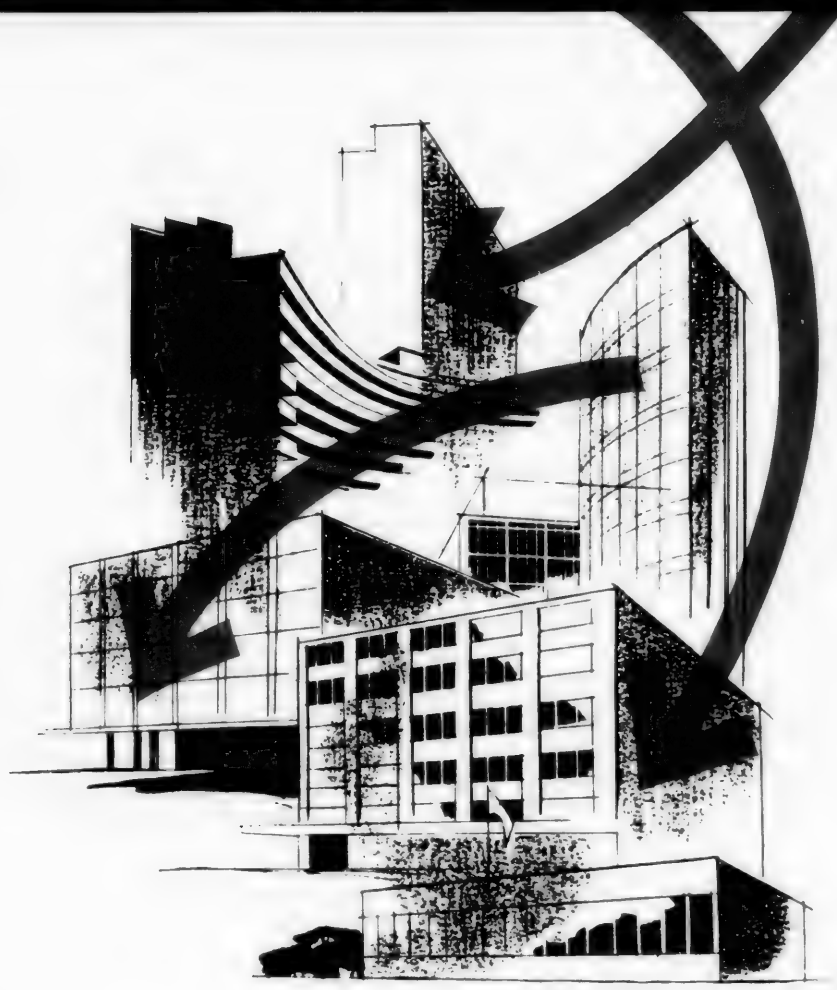


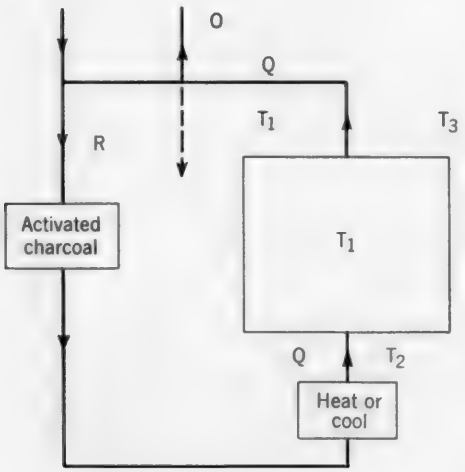
Calculate the advantages of recirculated air

H. L. BARNEBEY, Gen. Mgr.
BARNEBEY-CHENEY CO.
Columbus, Ohio

TO REDUCE AIRBORNE DIRT in a building, many engineers have turned to air-recovery systems. In this type of system, an electronic air cleaner or high efficiency mechanical filter, for particulate removal, and activated charcoal, for odor removal, are considered as a unit. It is by removing dirt and odor, and thereby reducing the outside air requirements, that an air-recovery system makes possible substantial savings in heating and cooling costs over a conventional air conditioning system. Here is an approach to system design and savings analysis that can be used for a quick look at economics or an exact calculation, depending on how much detail is used.

In the diagram, page 60, the space is maintained at temperature T_1 while the outside temperature is T_3. Air is recirculated at R cfm, purified by activated charcoal, re-cooled or re-heated as necessary and returned to the space. Outside air is introduced to the system by infiltration or as needed, and an equal quantity is discharged to the atmosphere. By means of a heat balance we can show that the heat requirement (or refrigeration requirement if the sign is negative) is made up of three major parts—the loss

through the wall, the heat required for outside air, and the internal heat gain.



$$H = 1.08\,Q\,(T_2 - T_1)$$
$$= L\,(T_1 - T_3) + O\,(T_1 - T_3) - G$$
$$= \Delta t\,(L + O) - G$$

The meaning of the symbols is as follows:

- H — is total heat (or cooling if the sign is negative) required in Btu per hr. This is determined by all conditions of problem including ventilating system.
- Q — is total air flow in cfm for ventilation and for heat transfer. It is the same whether recirculation is used or not.
- R — Recirculated air, cfm.
- F — $(Q - R)/Q$ = fraction of outside air.
- T_1 — is inside temperature and air exhaust temperature, deg F.
- T_2 — is air entering temperature, deg F.
- T_3 — is outside temperature, deg F.
- Δt — is inside temperature minus outside temperature $(T_1 - T_3)$, deg F.
- L — is heat loss from space due to temperature difference between inside and outside, in Btu per hr per deg F
- O — is heat required for outside air (Btu per hr per deg F) = cfm × 1.08 × (correction factor for latent heat, obtained by comparing enthalpy change with dry bulb temperature change—covers water removal in summer and water addition in winter)
- G — is internal heat gain (sensible plus latent), in Btu per hr.

With this simple formula for heat requirement which can be as accurate as you wish by use of suitable correction factors, you can plot a line which shows the amount of heat or cooling required for any outside temperature. The line will be different for each design condition, type of building, and type of ventilating system. For example, in a simple problem we may have Formula A for the use of all outside air and Formula B for the use of one-third outside air and two-thirds recirculated air:

$$\text{(A) } H = \Delta t\,(25{,}000 + 90{,}000) - 800{,}000$$
$$= 115{,}000\,\Delta t - 800{,}000 \text{ Btu per hr}$$
$$\text{(B) } H = \Delta t\,(25{,}000 + 30{,}000) - 800{,}000$$
$$= 55{,}000\,\Delta t - 800{,}000 \text{ Btu per hr}$$

In this case we have assumed the inside temperature to be the same (75 deg) for both summer and winter, and have also assumed that the heat gain and certain other factors do not change. This is an oversimplification but illustrates the method. For any particular outside temperature the heat or refrigeration savings by the use of air recirculation and purification can be read directly from the difference between the two lines. See Fig. 1.

Let us now take a more nearly actual case where the inside temperature is different summer and winter and the heat gains are also different. The

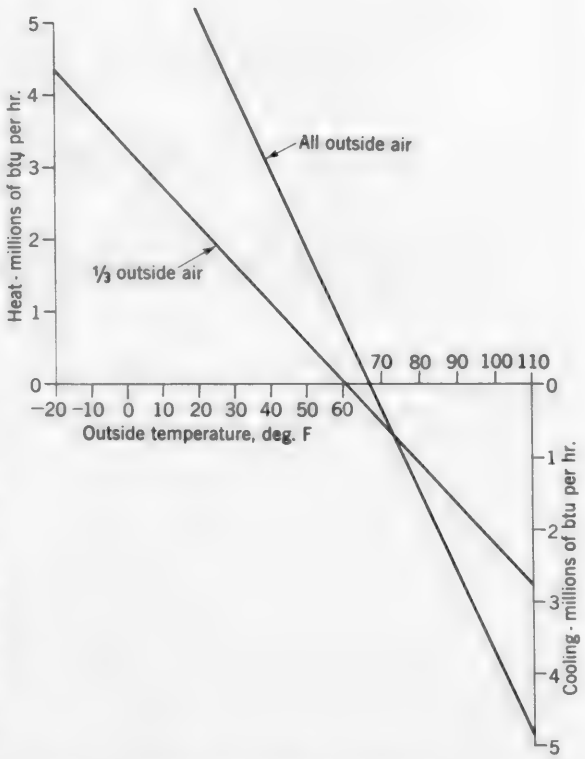


Fig. 1. Heating or cooling required at various outside temperatures for 75 deg inside temperature, both summer and winter.

Heat Requirement vs. Outside Temperature

(Data for Preparing Diagram of Fig. 2)

	T_1 deg F	L	O	L + O	G	T_3 where H = Zero	Heat Required at Chart Limit
Winter-Total Outside	70	30,000	75,000	105,000	1,000,000	60.5	8,450,000
Winter-⅓ Outside	70	30,000	25,000	55,000	1,000,000	51.8	3,950,000
Summer-Total Outside	78	25,000	105,000	130,000	600,000	73.4	—4,760,000
Summer-⅓ Outside	78	25,000	35,000	60,000	600,000	68	—2,520,000

placement and slope of the lines are changed somewhat, as shown by Fig. 2.

The heat required per hour for any outside temperature can be easily read for any of the lines and differences are indicated by simple subtraction. These differences show the heat or refrigeration savings which can be obtained by air recirculation and purification. For example: at an outside temperature of 30 deg, 3,170,000 Btu per hr are required using all outside air and 1,150,000 using one-third outside air. The difference, 2,020,000, represents the heat saving by using partial recirculation as compared with all outside air. Using seasonal, month by month, or day by day outside temperatures, both peaks and averages can be obtained to be used in equipment design and operating cost calculations.

Using the same system, let's see what happens if we vary the amount of outside air. This family of lines (Fig. 3) shows the heat requirement at 1/10, 1/5, ¼, ⅓, ½, and all outside air.

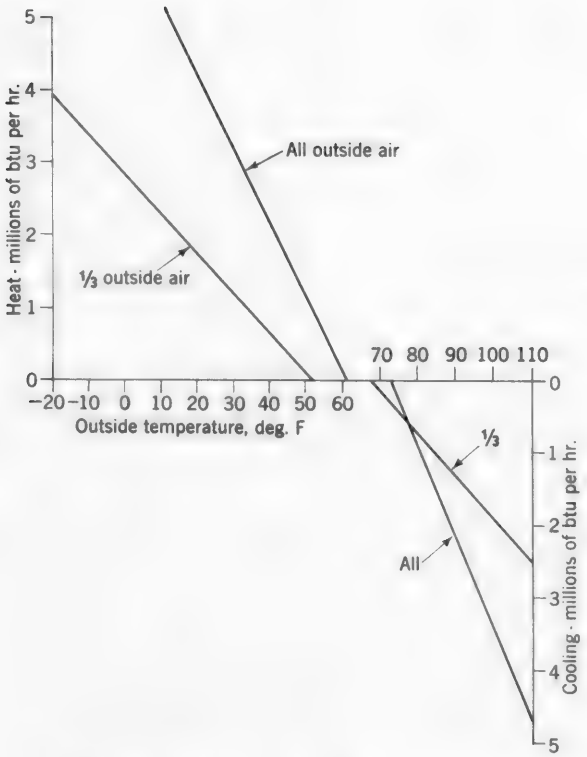

Heat · millions of btu per hr.
All outside air
⅓ outside air
Outside temperature, deg. F
−20 −10 0 10 20 30 40 50 60
70 80 90 100 110
⅓
All
Cooling · millions of btu per hr.

Fig. 2. Heating or cooling required at various outside temperatures for different summer and winter inside temperature and heat gains.

Variation in Heat Requirement with Fraction of Outside Air

(Data for Preparing Diagram of Fig. 3)

Winter, 70 deg inside: H = 30,000 △t + F (75,000 △t) − 1,000,000

F	Heat Required at Chart Limit	T_3 where H = Zero
1	8,450,000	60.5
½	5,075,000	55.2
⅓	3,950,000	51.8
¼	3,387,500	49.5
1/5	3,050,000	47.8
1/10	2,375,000	43.3

Summer, 78 deg inside: H = 25,000 △t + F (105,000 △t) − 600,000

F	Heat Required at Chart Limit	T_3 where H = Zero
1	—4,760,000	73.4
½	—3,080,000	70.3
⅓	—2,520,000	68.0
¼	—2,240,000	66.2
1/5	—2,072,000	65.0
1/10	—1,637,000	61.1

Using data from these lines, we can then prepare another set of curves (Fig. 4) that shows the percentage savings in heat and refrigeration, depending on the degree to which the outside air is reduced. In the transition range between winter and summer we follow the all outside air curve where this shows an economic advantage since our recirculation system is set up to use whatever quantity of outside air we want.

Heat and Refrigeration Savings at Various Outside Air Fractions

(Data for Preparing Curves of Fig. 4)

Outside Temperature, deg F	Heat and Refrigeration Savings ½ Outside Air BTU/hr	%	¼ Outside Air BTU/hr	%	1/10 Outside Air BTU/hr	%
—20	3,375,000	39.9	5,062,000	59.9	6,075,000	71.9
20	1,880,000	44.5	2,820,000	66.6	3,400,000	80.5
40	1,130,000	52.1	1,680,000	78.5	2,069,000	94.5
43.3					1,800,000	100
49.5			1,160,000	100		
55.2	560,000	100				
78						
80	100,000	11.5	150,000	17.7	210,000	24.4
90	600,000	27.9	940,000	43.3	1,170,000	53.9
100	1,170,000	33.7	1,720,000	49.4	2,170,000	62.5
110	1,680,000	35	2,520,000	52.9	3,123,000	65.5

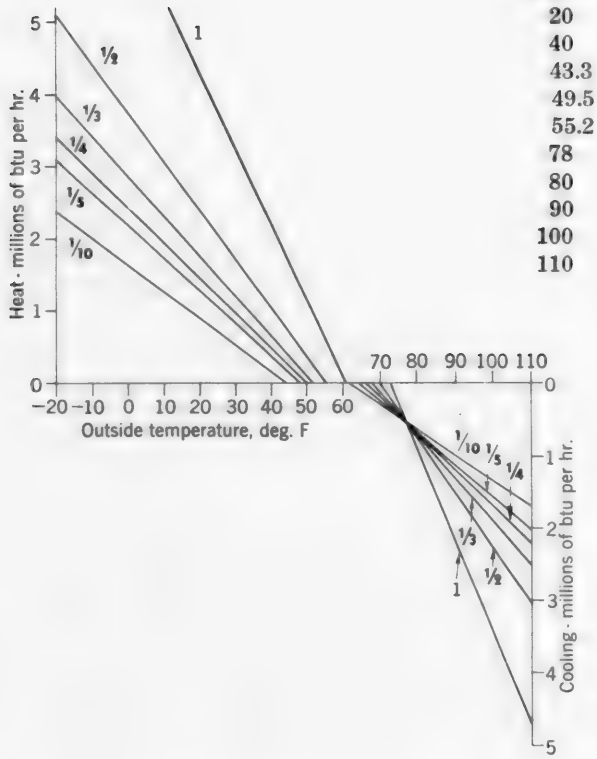


Fig. 3. Heating or cooling requirement at various outside temperatures for various fractions of outside air.

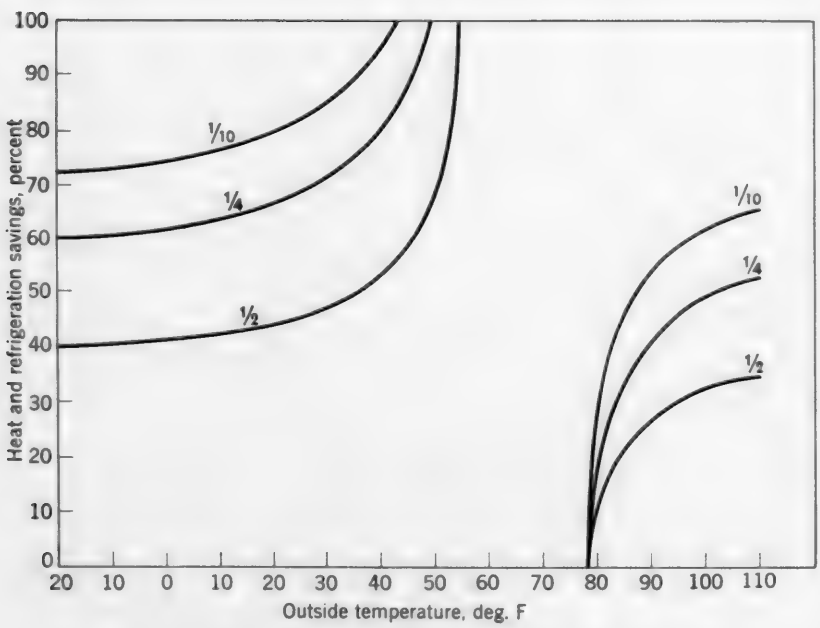


Fig. 4. Percentage savings in heat and refrigeration for various fractions of outside air.

These calculations and curves show that recirculation with air purification, as a ventilating tool, gives the engineer a new flexibility in the design of systems to give better air quality and better temperature control at lower cost.

New Method for Determining

Outlet Air Quantities

In Air-Conditioning Systems

DOUGLASS H. MAY

A-E Floor Product Manager
Granco Steel Products Company
St. Louis, Missouri

By using the procedure presented in this article, outlet air quantities can be adjusted — for temperature rise in the supply duct and for supplementary cooling when the cold duct runs through a conditioned space — directly on the design drawings, since all steps involve only simple multiplications readily performed on the slide rule.

OUTLET AIR QUANTITIES, in any air-conditioning system, depend not only on room sensible heat load, but on duct heat gain, because supply air gains heat both inside and outside of the conditioned space. In addition, outlet air quantities may have to be modified to account for supplementary cooling by cold duct surfaces inside the conditioned space.

To make a reasonably accurate evaluation of outlet air quantities, one determines the air temperature rise within the duct by calculation from heat transfer equations or, if available, directly from prepared curves. But even when the curves are available, the calculations are tedious; temperature rise must be translated into terms of air quantity at every outlet.

The usual determination of outlet air quantities involves, first, the establishment of a set of values neglecting duct heat gain. In other words, it is assumed that air temperature at each outlet is the same as air temperature leaving the cooling coils. Then, temperature rise is determined along each section of duct between take-offs and outlets and added to the previously assumed temperature. Finally, outlet air quantities are adjusted in accordance with the following:

$$adjusted\ outlet\ cfm = outlet\ cfm \frac{t_r - t_i}{t_r - t_f} \quad (1)$$

where t_r = Conditioned room temperature, deg F,
t_i = Initial temperature of supply air, deg F, and
t_f = Final temperature of supply air, deg F.

When the duct is in the conditioned space, *adjusted outlet cfm* from Equation (1) must be reduced to account for the supplementary cooling provided by the duct, as follows:

$$outlet\ cfm\ deduction = duct\ cfm \frac{t_f - t_i}{t_r - t_f} \quad (2)$$

where $t_f - t_i$ = temperature rise of supply air, deg F. *Duct cfm* is the air quantity that has gone through a temperature rise, $(t_f - t_i)$ in the duct section preceding the outlet.

This article introduces an accurate and simplified method for determining outlet air quantities without having first to determine temperature rise and then having to translate the rise at each outlet into air quantity.

How the "z" Factor Simplifies

The basic heat transfer equation relating final supply air temperature, t_f, to ambient and initial air temperatures, t_a and t_i, is[1]

$$\frac{t_a - t_i}{t_a - t_f} = e^z \quad (3)$$

$$\text{where } z = \frac{U \times perimeter \times length}{60 \times density \times c_p \times CFM} \quad (4)$$

and U = Overall coefficient of heat transfer, Btu per (hr)(deg F)(sq ft),
c_p = Specific heat of air, Btu per deg F, and
CFM = Air quantity required at temperature t_i.

[1]Superscripts refer to references at end of article.

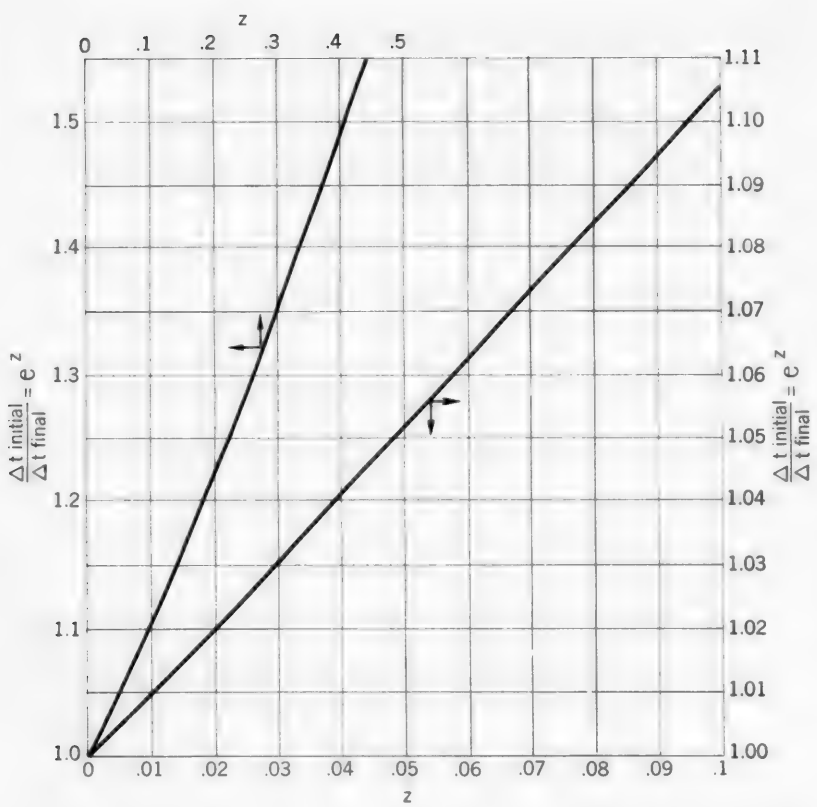


Fig. 1. Plot of z against e^z shows that (1+z) is approximately equal to e^z, especially when z is small, as in lower right half of graph. The error amounts to about 3% when e^z is as large as 1.3.

If ambient air temperature, t_a, equals the temperature of the conditioned space, t_r, then, by substitution, Equation (1) can be rewritten

$$adjusted\ outlet\ cfm = outlet\ cfm \times e^z. \qquad (5)$$

It can be seen from Fig. 1, a plot of e^z against z, that $(1 + z)$ closely approximates e^z. Therefore,

$$adjusted\ outlet\ cfm \cong outlet\ cfm \times (1 + z) \qquad (6)$$

The error in using Equation (6) varies from 0.5%, in the normal range of temperature ratios, to 3% at a ratio of 1.3. An increase in *outlet cfm* by a factor of 1.3 may be required at the end of a very long run of duct.

As already mentioned, account must be taken of the cooling effect of a cold duct surface in the conditioned space. Usually this is accomplished by use of Equation (2). As with duct heat gain, application of the z factor to this equation simplifies the relationships. Rearranging Equation (3), we have

$$t_f = t_a - (t_a - t_i)e^{-z}$$

and deducting t_i from both sides of the equation,

$$(t_f - t_i) = (t_a - t_i) - (t_a - t_i)e^{-z}$$

Dividing both sides by $(t_a - t_i)$,

$$\frac{t_f - t_i}{t_a - t_i} = 1 - e^{-z} \qquad (7)$$

From Fig. 1, by inspection, e^z was found to be very close to $(1 + z)$, so that $e^{-z} \cong 1/(1 + z)$ and $(1 - e^{-z}) \cong 1 - (1/1 + z)$, which, after simplification becomes $z/(z + 1)$. Thus,

$$1 - e^{-z} \cong z/(z + 1). \qquad (8)$$

Rearranging Equation (2),

$$outlet\ cfm\ deduction = duct\ cfm \frac{(t_f - t_i)}{(t_r - t_i) - (t_f - t_i)}$$

$$= \frac{duct\ cfm}{\frac{t_r - t_i}{t_f - t_i} - 1}$$

Where $t_a = t_r$, from Equations (7) and (8),

$$outlet\ cfm\ deduction = \frac{duct\ cfm}{\frac{z + 1}{z} - 1}$$

which, upon simplification, becomes

$$outlet\ cfm\ deduction = duct\ cfm \times z \qquad (9)$$

By applying Equations (6) and (9) in lieu of equivalent Equations (1) and (2) it is no longer necessary to calculate temperature changes and ratios along a length of duct before outlet air quantities can be determined. The practicality of bypassing temperature calculations is that temperatures are not usually of interest other than as a means of calculating air quantities.

Figure 2 shows a comparison of the theoretical final temperature, t_f, with the final temperature, t_f, based on test results.[2] Calculated temperatures in the comparison have been evaluated on the basis of the

properties of air at 200 deg F, the initial temperature, t_i, of the supply air in the reference literature. Close agreement between theoretical and test values for the 6-inch duct is shown. Exact agreement is shown for the 30-inch duct.

An illustration justifying the approximation of Equation (8) is shown in Fig. 3. It is important to note that the closest agreement occurs at the lower values of z. Referring to Equation 4, it can be seen that the z-factor decreases as the U value and length becomes lower and the duct diameter becomes larger. In air conditioning applications, small duct diameters usually occur in short lengths. In addition, ducts in unconditioned spaces are usually insulated. The net result is that lower z values invariably apply to air conditioning duct.

It is pointed out again that Equation (6) applies specifically to the case where the ambient temperature is equal to the temperature of the conditioned space. For the case where the ambient temperature is not equal to the conditioned space temperature, application of Equation (6) to adjust supply air quantities results in some error. The degree of error depends upon the deviation of the ambient temperature from the temperature of the conditioned space and the z factor. It has been found by analysis of several examples, that when the rate of $\frac{t_a - t_i}{t_r - t_i}$ equals 2, the *adjusted cfm* is on the low side by an amount numerically equal to the z factor times the *adjusted cfm*.

Example 1

Given:

$t_a = 100$ deg F
$t_r = 75$ deg F
$t_i = 50$ deg F
$z = .02$
cfm based on temp (t_i) = 3000

Find:

cfm required to compensate for duct heat gain from the unconditioned space.

Solution:

$$\textit{adjusted cfm} = 3000 \times (1 + .02) = 3060$$

Since the duct is in an unconditioned space, the value 3060 *cfm* is low by a factor equal to the z factor, or 0.02. Therefore, a more exact air quantity is:

$$\textit{adjusted cfm} = 3000 \times (1 + .04) = 3120, \text{ a difference of } 60 \textit{ cfm}$$

Heat Gain to Round Duct

Figure 4 is an example of a heat gain chart designed to illustrate the relationship between the z factor, *cfm*, velocity, and duct diameter.

By analyzing Fig. 4, it can be seen that the possible occurrence of a z factor greater than 0.1 is remote. At a z value of 0.1, Fig. 3 shows that the percent error in assuming that the temperature rise equals $z/(z + 1)$ is 4%.

Fig. 4 is plotted specifically for the case of conditioned air at a temperature of 50 deg in painted duct. The z factor is calculated by the following modification of Equation (4) to fit the stated condition:

$$z = \frac{44.4\, U\, L}{V\, d} \qquad (10)$$

where $U = \dfrac{1}{\frac{1}{h_f} + \frac{1}{h_o}}$

L = length, ft
V = velocity, fpm
d = duct diameter, inches
h_f = inside film factor, Btu per (hr) (deg F) (sq ft) = $.0193\, V^{0.8}/d^{0.2}$
h_o = outside film factor, Btu per (hr) (deg F) (sq ft) = 1.65 (bare, painted duct)

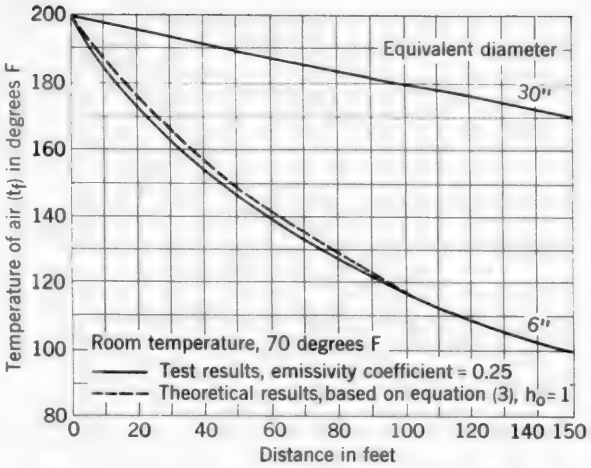

Temperature of air (t_f) in degrees F
Distance in feet
Equivalent diameter
30"
6"
Room temperature, 70 degrees F
Test results, emissivity coefficient = 0.25
Theoretical results, based on equation (3), $h_o = 1$

Fig. 2. Comparison of theoretical temperature rise with test results when air velocity is 600 fpm.

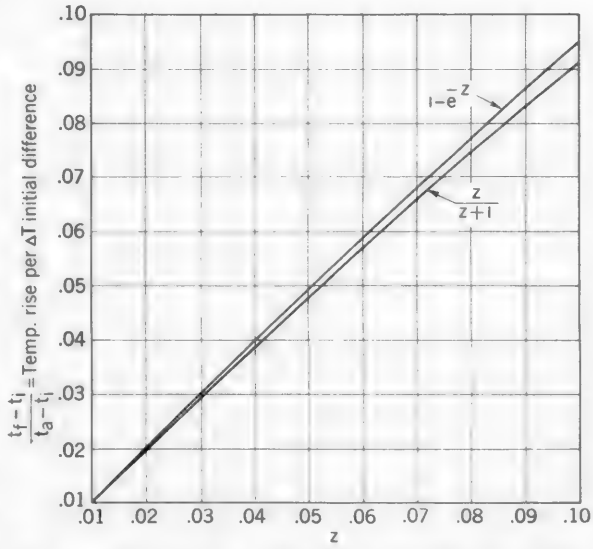


Fig. 3. Comparison of theoretical temperature rise with approximated rise, justifying approximation in Eq. (8).

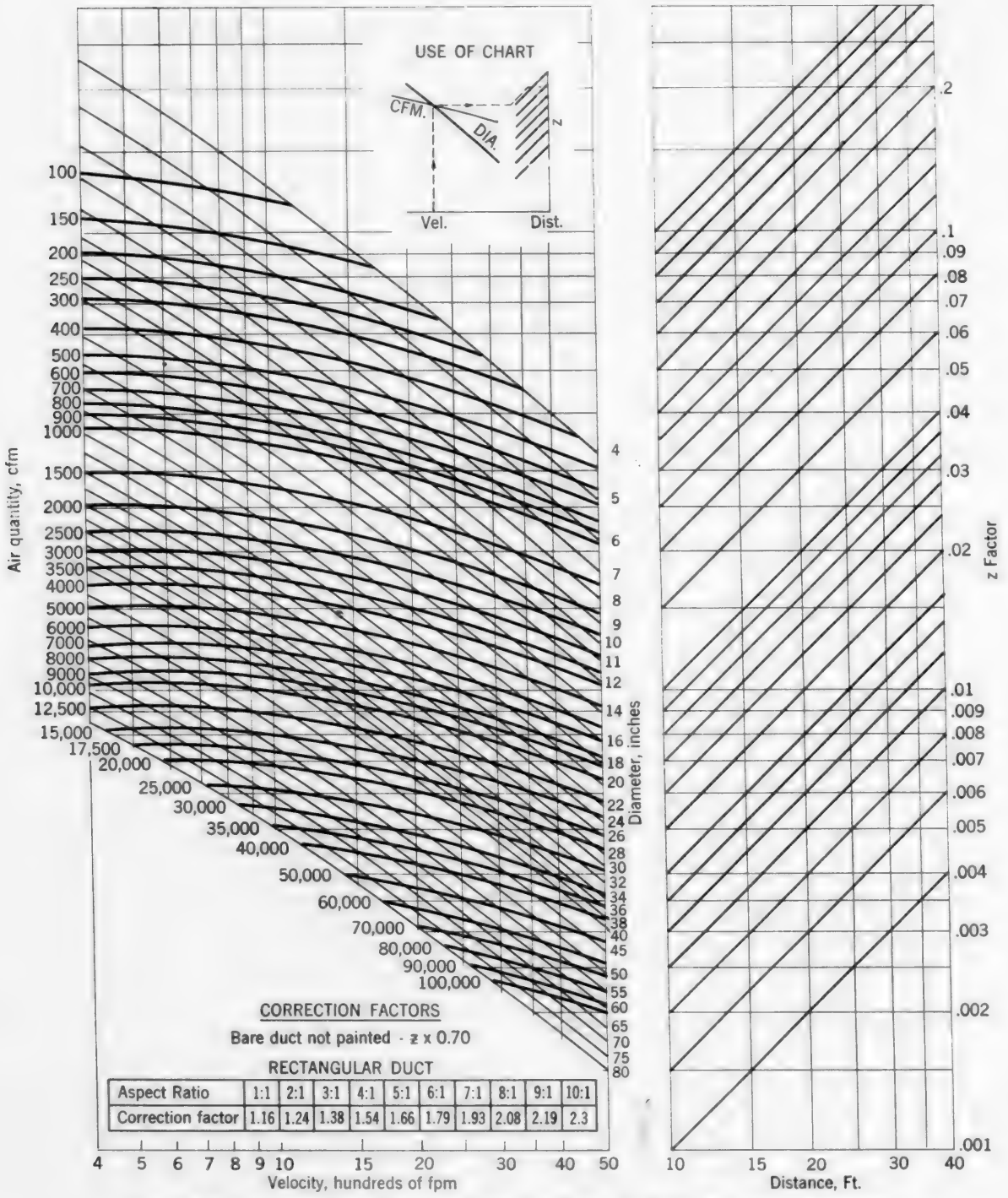


Fig. 4. Bare duct heat gain for round painted duct with h_o of 1.65, illustrating relations between z, cfm, velocity, and duct diameter.

Similar calculations can be made for insulated duct, or bare duct not painted by the applicable evaluation of *U*.

Heat Gain to Rectangular Duct

Aspect ratio has a significant influence on heat gain to rectangular duct. Heat gain to a duct with an aspect ratio of 4:1 is considerably greater than to a duct of the same circular equivalent diameter with an aspect ratio of 1:1. Because of the variable quantity introduced by the aspect ratio, it is not convenient to present duct heat gain in terms of rectangular duct. Therefore, duct heat gain is presented in terms of round duct and then converted to circular equivalent rectangular diameter. The circular equivalent diameter duct is based on equal friction and equal capacity. The situation is equivalent to determining the friction loss in rectangular duct in terms of circular

equivalent diameters which are also based on equal friction and capacity.

Conversion from Round to Rectangular Duct

Since duct heat gain is most conveniently expressed in terms of the z-factor, the following derivation is aimed at determining conversion factors to be applied to the z-factor.

Equation (10),

$$z_{ro} = \frac{44.4\,U\,L}{V_{ro}\,d}$$

Also, for rectangular duct,

$$z_{re} = \frac{44.4\,U\,L}{V_{re}\,4fa} \tag{11}$$

where: $4fa$ = hydraulic diameter of rectangular duct

Further,

$$\textit{Conversion factor} = z_{re}/z_{ro} = \frac{V_{ro}\,d}{V_{re}\,4fa} \tag{12}$$

and for equal capacity and equal friction,

$$V_{ro}/V_{re} = \frac{4\,CFM/\pi d^2}{CFM/ab} \tag{13}$$

where V = velocity, fpm,

d = circular equivalent diameter of rectangular duct, based on equal friction and equal capacity,

a = length of short side of duct, inches,

b = length of long side of duct, inches,

CFM = air quantity required at initial temperature, t_i, and the subscripts re and ro refer to rectangular and round duct, respectively.

Substituting Equation (13) for V_{ro}/V_{re} in Equation (12),

$$z_{re}/z_{ro} = b/\pi\,df \tag{14}$$

The equation for the circular equivalent diameter of rectangular duct, based on equal capacity and equal friction, is[3]

$$d = 1.3\,a\,\frac{n}{(1+n)} \tag{15}$$

Also,

$$f = \frac{n}{2(1+n)} = \frac{b/a}{2(1+n)} \tag{16}$$

where n = aspect ratio, b/a.

By substituting Equations (15) and (16) into Equation (14),

$$z_{re}/z_{ro} = 0.49(n+1)^{1.242}/n^{0.621} \tag{17}$$

Equation (17) is solved and the results shown in the lower, left-hand corner of Fig. 4.

In the above derivation, no account was taken of the fact that the U factor should be slightly modified when converting from round to rectangular duct. The equivalent diameter duct is based on equal capacity and friction but not equal velocity. In addition, the hydraulic diameter used in calculating h_f and the equivalent duct diameter based on equal friction and equal capacity are not the same value. The inside film factor for rectangular duct is expressed in terms of velocity and hydraulic diameter as follows:

$$h_f = 0.0193\,\frac{V^{0.8}}{(4fa)^{0.2}} \text{ or}$$

$$h_f = 0.0193\,\frac{V^{0.8}}{\left(\dfrac{2ab}{a+b}\right)^{0.2}}$$

An example of the error resulting when the inside film factor is not modified when converting from round to rectangular duct follows.

Example 2

Given:

duct diameter = 12 inches

velocity = 1000 fpm

Find:

h_f for 12-inch dia duct and the equivalent rectangular duct based on equal capacity and friction. Assume bare duct not painted, where $h_o = 1$.

Solution:

Round duct, $h_f = .0193\dfrac{(1000)^{0.8}}{(12)^{0.2}}$

$= 2.94$

$$U = \frac{1}{\dfrac{1}{2.94} + 1}$$

$= 1.34$

Equivalent rectangular duct (22″ x 6″),

$h_f = .0193\dfrac{(850)^{0.8}}{(9.4)^{0.2}}$

$= 2.7$

$$U = \frac{1}{\dfrac{1}{2.7} + 1}$$

$= 1.37$

It can be seen from the above calculations that the U value of round duct and the equivalent rectangular duct is essentially the same. In the example, the rectangular duct selected has an aspect ratio of almost 4:1. Had a duct with a smaller aspect ratio been selected, the difference in U value would have been even less.

Application of Proposed Method

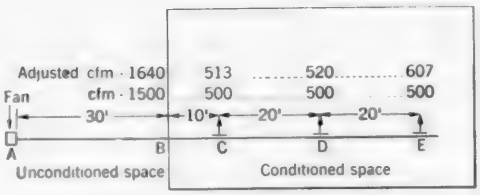
Example 3 illustrates the application of the z-factor to adjust outlet air quantities in an air conditioning system. The example selected represents an application most favorable to the use of the z factor, and that is when the initially established air quantities at all outlets are equal, *a situation that occurs quite often*. In the example selected, each initial outlet air quantity is 500 cfm.

When initial outlet air quantities are not equal, the factors $(1+z)$ must be multiplied throughout a length of duct to establish the *cfm* increase due to

Example 3

Given:

Room supply air temperature	55 deg F
Room supply air quantity	1500 cfm
Room air temperature	75 deg
Unconditioned space temperature	95 deg
Initial velocity	1400 fpm
Duct aspect ratio	2:1
Duct is bare, painted, and sized by the constant friction method	



Steps at Location	*Procedure*	*Calculations*	*Results*
A-B			
1	*z* factor	chart reading	.074
2	correct for rectangular duct	.074 × 1.24	.092
3	*cfm at point B*	1500 (1 + .092)	*1640*
B-C			
1	*z* factor	chart reading	.025
2	correct for rectangular duct	.025 × 1.24	.031
3	outlet cfm increase	500 (1 + .031) (1 + .092)	564
4	cfm deduction	1640 × .031	51
5	*adjusted outlet cfm*	564 – 51	*513*
C-D			
1	*z* factor	chart reading	.062
2	correct for rectangular duct	.062 × 1.24	.077
3	outlet cfm increase	564 (1 + .077)	607
4	cfm deduction	1127 × .077	87
5	*adjusted outlet cfm*	607 – 87	*520*
D-E			
1	*remain cfm*	1640 – 513 – 520	*607*
	check:		
	z factor	chart reading	.086
	correct for rectangular duct	.086 × 1.24	.1065
	outlet cfm increase	.607 (1 + .1065)	672
	cfm deduction	607 × .1065	65
	adjusted outlet cfm	672 – 65	*607*

temperature rise (see calculation at location *B-C*). Under the conditions in the example, however, the multiplication of $(1 + z)$ factors is automatically taken care of. For example, at location *C-D* the quantity 564 (1 + .077) is the same as 500 (1 + .03) (1 + .092) (1 + .077).

Z-Factor Applied to Evaluate Insulation Requirements

By referring to example 3, it can be seen that the air quantity entering the conditioned space is increased by a factor of $(1 + z)$ to account for duct heat gain. Therefore, the factor z and $(1 + z)$ is a direct measure by which it can be determined if insulation is required. For example, if the z factor is 0.1 and the duct is an unconditioned space, the supply air quantity is increased 10% because of duct heat gain. If this is too high an increase, insulation must be added.

Summary

When duct heat gain is accounted for in terms of temperature rise, it is necessary to set up a table or bookkeeping procedure to keep track of the temperature differences and ratios. By using the procedure presented in this article, outlet air quantities can be adjusted directly on the design drawings, since all steps involve simple multiplication procedures that can readily be performed on the slide rule.

References

1. ASHRAE *Guide*, 1955.
2. *Temperature Drop In Ducts For Forced-Air Heating Systems*, University of Illinois Engineering Experiment Station Bulletin, Series 351.
3. *Fan Engineering*, 5th ed.

WANTED: Data for the Cooling Degree-Day

WHAT IS THE STATUS of the cooling degree-day? In a series of three articles* in ACH&V, U. S. Weather Bureau meterologist Earl C. Thom laid the foundation for

". . . . . a cooling degree-day system that would be a useful measure of the amount of energy required to operate existing air-conditioning installations from month to month and from season to season. When normals for such a system are established, it would then be possible to explain with better logic the variations in energy used by an air-conditioning installation. When such a system is adopted, there is the likelihood that it would be possible to predict the cooling degree-day values for each coming month."

The Temperature-Humidity Index (Discomfort Index) was used as the basis for the study, since it took into account both temperature and humidity, both of which are important factors in the cooling load, unlike the case of the winter heating degree-day, which is based on outside temperature alone.

Base 60 Challenged

Mr. Thom pointed out that a number of refinements needed consideration, and that "more work needs to be done to ascertain whether or not 60 is the best possible base".

According to the Office of Climatology of the Weather Bureau, recent data suggest that a base of 68 or 70 is required.

How Readers Can Help

At this point, certain data that may be in the possession of readers of this magazine could be most useful to the Bureau. What are needed are separately metered load data on air conditioning installations of many different kinds, including commercial, industrial, institutional, and residential, especially apartment-house installations in the last category.

To be *most* useful, these data should have been recorded on a daily basis (in order to be able to compare them with daily temperature-humidity readings) and extend over an entire cooling season.

Please do not submit these data, if available, at this time. With its very limited staff, the Office of Climatology could easily be swamped by reports it cannot use. To avoid this, an informal arrangement has been concluded as follows:

1. Those persons who are in possession of data of the type described above and who will be kind enough to loan this material for cooling degree-day research are asked to write The Editor, Air Conditioning, Heating and Ventilating, 93 Worth St., New York 13, N.Y., outlining

   (a) what data are being offered,

   (b) in what increments of time (daily, weekly, monthly) they were recorded,

   (c) the period of time (1961 cooling season, etc.) over which the records were kept, and

   (d) the locale (state, city or county) from which the data originate.

2. All offers of data received at ACH&V will be collected and turned over to the office of Climatology. Those who have data that the Office believes will prove useful will be asked to send these data directly to Washington.

This Spring, More Data

It is hoped that sufficient data are available to enable the Weather Bureau to ascertain not only what the proper base of the cooling degree-day should be but what variables, if any, other than temperature and humidity, ought to be considered in establishing meaningful norms. If these conclusions can be reached in time, it may be possible for our readers to cooperate further during the coming cooling season, collecting data over the whole United States in accordance with a plan the Bureau may devise.

The heating degree-day has become a well-established tool in design and maintenance of heating systems. There is every reason to believe that the cooling degree-day will prove at least as valuable for the air-conditioning industry.

* "Measuring the Need for Air Conditioning," August, 1956; "A New Concept for Cooling Degree-Days," June, 1957; and "Cooling Degree-Days," July, 1958.

U-VALUE CORRECTIONS by ELECTRICAL ANALOGY

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THIS article is a continuation of the idea expounded in the article, "Where 'U' Values Can Mislead" in the April 1961 issue of AIR CONDITIONING, HEATING, AND VENTILATING, which pointed out the main shortcomings of the "U-value" method of calculation.

This article introduces the analogue method of quick measurement of heat losses in complex configurations. It is easy to follow, and requires only some standard resistances and a few wires to solve most complex problems of steady state heat transfer, or even of non-steady state phenomena.

Non-steady state heat transfer is of high interest in some industrial applications, and affects the heating and air-conditioning calculations in the cases of badly insulated thick walls constructed of high thermal capacitance material. Since this type of construction is becoming an exception, rather than the rule of modern construction of large buildings, this article deals only with steady state problems.

Mathematical background of the method is sketched first. It is not necessary to follow it in order to apply the method, and the reader may be excused for jumping directly to the section entitled "Practical Solutions" if he is primarily interested in the direct applications of the method.

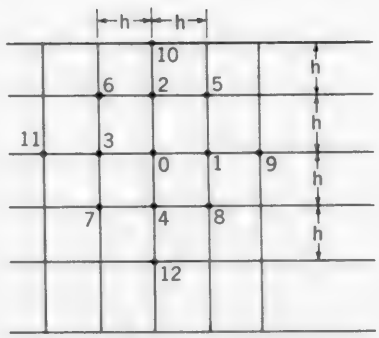


Fig. 1. Diagram of a square net of solid material with only two-dimensional heat transfer considered.

Table 1—Analogous Quantities in Electricity and Heat Transfer

ELECTRICAL NETWORK		HEAT TRANSFER	
Electrical current (amperes)	$i \longrightarrow$	Rate of heat flow (Btuh)	$\frac{dQ}{dt}$
Potential (volts)	$V \longrightarrow$	Temperature, deg F	T
Conductance (1/omh)	$\frac{1}{R} \longrightarrow$	Thermal conductivity x area (Btuh per deg F)	KA
Capacitance (farads)	$\longrightarrow$	Thermal capacitance (Btu per deg F)	

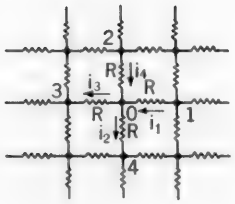


Fig. 2. An electrical grid with resistances, analogous to two-dimensional heat transfer.

Mathematical Background

For a homogeneous material, the one-dimensional Fourier's equation may be written in the form:

$$\frac{\delta T}{\delta t} = \frac{K}{c_p \rho} \frac{\delta^2 T}{\delta x^2} \tag{1}$$

In the 3-dimensional case, this becomes:

$$\frac{\delta T}{\delta t} = \left(\frac{K}{c_p \rho}\right) \nabla^2 T \tag{2}$$

where $\nabla^2 T$ stands for

$$\left(\frac{\delta^2 T}{\delta x^2} + \frac{\delta^2 T}{\delta y^2} + \frac{\delta^2 T}{\delta z^2}\right) \text{ and}$$

T = temperature,
t = time,
c_p = specific heat,
ρ = density,
K = conductivity
x, y and z = length of heat paths.

For steady state flow, this is reduced to:

$$\nabla^2 T = 0 \tag{3}$$

An immediate analogy may be obtained with the electrical current phenomena. The equations of flow of electrical current in a transmission line are

$$\left.\begin{aligned} i &= \frac{1}{R} \frac{dV}{dx} \\ \frac{di}{dx} &= -C \frac{dV}{dt} \end{aligned}\right\} \tag{4}$$

Eliminating i from equation (4), we have:

$$\frac{\delta^2 V}{\delta x^2} = -CR \frac{\delta V}{\delta t} \tag{5}$$

recognized as the special case of the so-called telegraph equation for negligible inductance.

For steady state condition, Equation (5) is reduced to the form:

$$\nabla^2 V = 0$$

analogous to Equation (3) The analogous quantities are given in Table 1.

Since the equations of flow of heat or of electricity in solids are identical, the measurements of the flow of electricity will supply the answers for an analogous heat transfer problem.

The situation becomes clearer if the finite difference rather than a differential equation is used to express each physical problem. Restricting ourselves to a 2-dimensional situation (conditions in the third dimension are assumed uniform), we assume that temperature T is an analytical function of x and y (or that it may be expanded in Taylor Series).

A square net covering the solid material is shown in Fig. 1.

The derivatives may be replaced by finite difference operators as follows:

$$\begin{aligned} 2h \left(\frac{\delta T}{\delta x}\right)_o &= T_1 - T_3 \\ 2h \left(\frac{\delta T}{\delta y}\right)_o &= T_2 - T_4 \\ h^2 \left(\frac{\delta^2 T}{\delta x^2}\right)_o &= T_1 - 2T_o + T_3 \\ h^2 \left(\frac{\delta^2 T}{\delta y^2}\right)_o &= T_2 - 2T_o + T_4 \end{aligned} \tag{6}$$

and similarly for higher order derivatives (which will be ignored, since h is assumed to be small).

An approximate equation of steady state heat transfer may now be obtained from Equation (6):

$$h^2 \left[\frac{\delta^2 T}{\delta x^2} + \frac{\delta^2 T}{\delta y^2}\right] = T_1 + T_2 + T_3 + T_4 - 4T_o = 0 \tag{7}$$

Similarly, equations of electrical current flow in a two-dimensional network as shown in Fig. 2 are:

$$i_1 - i_2 - i_3 + i_4 = 0$$

while the voltage distribution must satisfy:

$$\frac{V_1 - V_o}{R} - \frac{V_o - V_2}{R} - \frac{V_o - V_3}{R} + \frac{V_4 - V_o}{R} = 0$$

or:

$$V_1 + V_2 + V_3 + V_4 - 4V_o = 0 \tag{8}$$

Since Equations (7) and (8) are identical, electrical networks can be built imitating the problems encountered in complex cases of heat transfer.

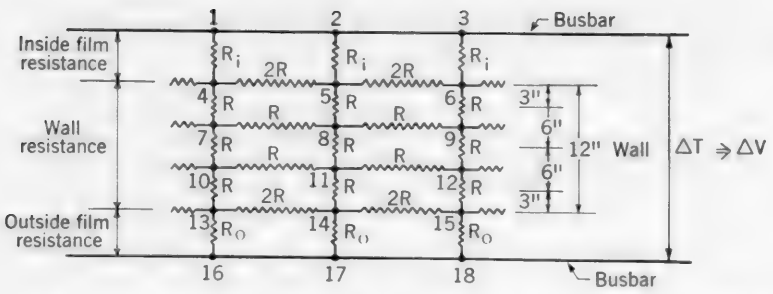


Fig. 3. Electrical circuit representing heat transfer through a large, uniform wall.

Practical Solution

This method is applicable to any 3-dimensional configurations. However, to avoid 3-dimensional circuitry, an attempt is made to simplify the situation and consider only 2-dimensional heat flow problems for the time being.

The electrical circuit representing a portion of a uniform large wall is shown in Fig. 3. (Notice that $2R$ instead of R is the resistance along the boundary of the material. This is necessary since the flow can proceed in the horizontal direction only through half of the thickness of one mesh.) The resistances R are arbitrary. However, ratios R/R_i and R/R_o must be retained the same as the ratios of the thermal resistances of equivalent wall portions and of the inside and outside film resistances. The voltage drop may represent the difference between the inside air temperature and the outside ambient air temperature to any scale.

The way in which suitable resistances can be chosen is illustrated by an example:

Let the wall section in Fig. 3 represent a 12-inch common brick wall with conductivity $K = 5.0$ Btu per (sq ft)(deg F)(inch thickness) and resistance $R = 1/K = 0.2$. Also x/K represents the resistance of each section.

Since Fig. 3 shows that the wall divided into 4-inch thick sections, $R = x/K = 4 \times 0.2 = 0.8$ for each section.

A decision has to be made regarding R_i and R_o. Assuming, for example, that the air inside is moving at a maximum of 2 mph, then $R_i = 0.60$; and if the wind outside is 15 mph, $R_o = 0.16$.

The following resistances can be used:

$$R = 800 \text{ ohms}$$
$$R_i = 600 \text{ ohms}$$
$$R_o = 160 \text{ ohms}$$

or any other values proportioned in the same ratio, to construct the network shown on Fig. 3. Since wall construction is uniform, zero current readings will be obtained in the horizontal connections, such as 7-8 or 4-5, and consequently the network could be simplified in this case as shown in Fig. 4.

This, in fact, is the network analogy of the U value formula. In the case of a uniform wall, therefore, there is no need for an electrical analogy. The U formula gives an exact result, subject to limitations on assumptions concerning R_i and R_o.

In case of non-uniform walls, however, U formulae may result in mistakes in excess of 100% of calculated values. This will be immediately apparent if section of the non-uniform wall in Fig. 5 is considered. In this case, the uniformity is disrupted by a thin insert of high conductivity but of small area, A. This could be represented by the network shown in Fig. 5a.

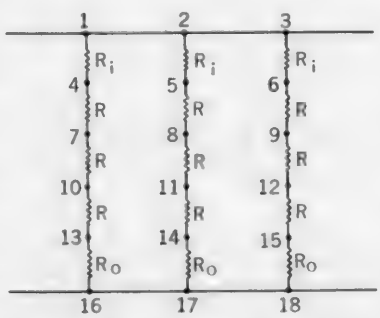


Fig. 4. Simplification of Fig. 3 network results in electrical analog to U value formula.

Some typical cases of non-uniform walls are illustrated in Figs. 6 — 7a (the subscripts denoting the electrical analogues). In Fig. 6, the resistances are:

Inside surface film resistance	0.65
4-inch face brick	0.40
4-inch common brick	0.80
Outside surface (15 mph wind)	0.16
Temperature difference	50 deg F

Resistances shown are in ohms. The values of current in amps have to be multiplied by the factor of 1000 to obtain the rates of heat flow in Btuh per sq ft.

Figure 7 shows the effects of partially embedded member of high conductivity. The resistances are:

Inside surface	0.65
6-inch concrete block	2.4

(note R-values of concrete blocks vary within very wide limits, and this value must not be regarded as "typical").

4-inch facing brick	0.40
Outside surface (15 mph wind)	0.16
Temperature difference	30 deg F

In Fig. 7a, if the resistances are in ohms, the scale factor is 1:1000 for conversion from amperes to Btuh per sq ft. Voltage distribution corresponds exactly to temperature distribution.

The method by now may be obvious to the reader. However it may be well to outline the main points:

Resistances may be chosen arbitrarily. It is only the ratios which are of importance. The important choice is of the fineness of the analogous mesh. The finer it is, the better it approximates the true pattern of heat flow, but also the more difficult the analogy is to construct.

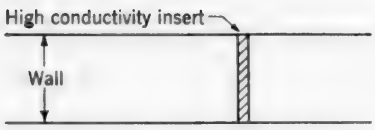
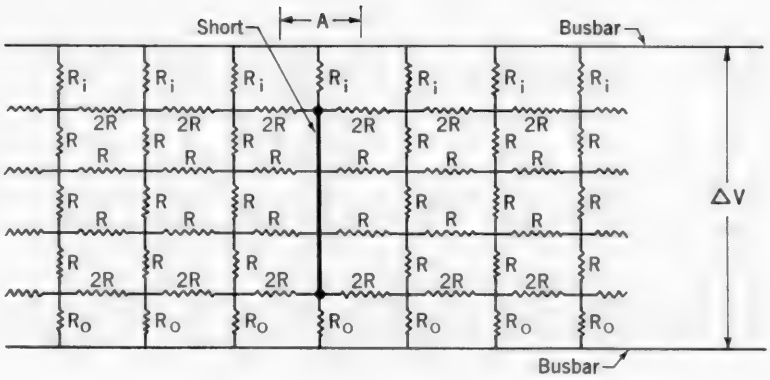


Fig. 5 (above). Insert in wall destroys validity of U-value formula. Heat flow is represented by network in Fig. 5a, right.



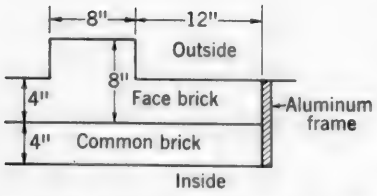
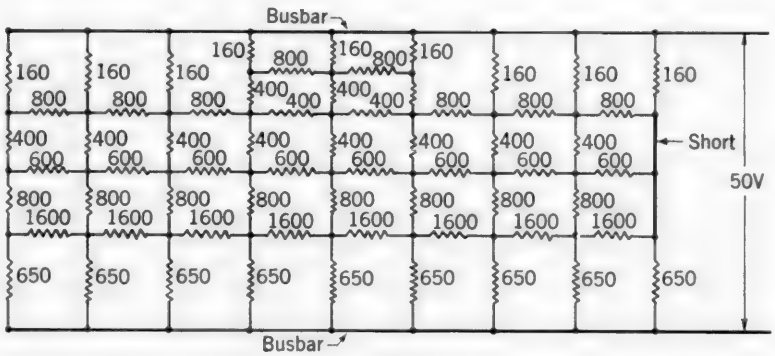


Fig. 6. Typical non-uniform wall, above, is shown in electrical analogy in Fig. 6a, right.



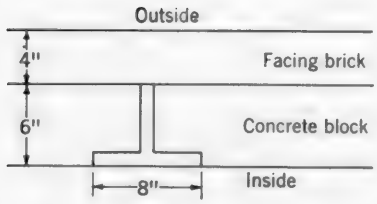
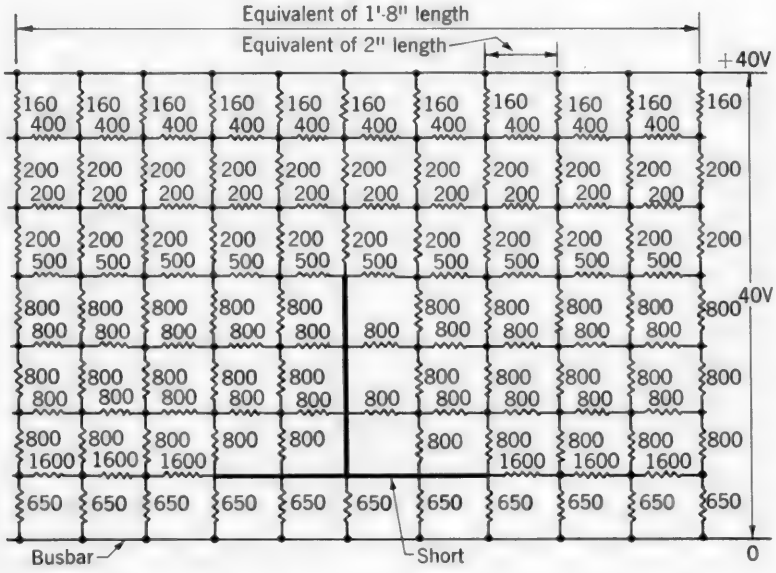


Fig. 7. Another typical non-uniform wall, above, and its electrical analogy in Fig. 7a, right.



Conclusions

The basic principles of analogue construction can be followed with limited insight into the mathematical theory. From a practical point of view, this constitutes a major tool of analysis in all cases where the *U* formula application is under suspicion.

It certainly should be used to obtain the thermal data supplied by manufacturers of architectural fittings, glass, aluminum frames or other fixtures. A study including construction of an electrical analogue should be recommended in most cases of curtain wall construction of very large buildings. Some features discovered by the analogue method may save large amounts of money expended on heating and ventilating equipment, on maintenance, taxes, etc. In fact, one of the most attractive features of this method is our ability not only to discover some inefficiencies, but also to be able to suggest the most effective remedies (the insertion of additional resistance representing local insulation) and to predict the exact differences in cost.

Control Methods for Electric Heating Systems

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Commercial Div., Minneapolis-Honeywell
Toronto, Ontario

Three basic forms of control are available for electric heating. Each type is most appropriate for a specific application of electric heat. These are all discussed, along with three methods of sensing, in this informative, graphically-illustrated article.

FOR YEARS ELECTRIC HEATING HAS BEEN RECOGNIZED as offering many excellent qualities. Recent economic improvements have increased its use in commercial-type buildings—schools, churches, office buildings, motels, factories—and this trend is expected to increase steadily. To a great extent, however, acceptance will depend on how well electric heating systems perform.

In the home, electric heat control has only to meet a relatively simple on-off standard.

In a commercial building, however, a more complex performance standard is required to satisfactorily control intricate systems of radiation, ventilation and air conditioning.

Based on experience with electric heating installations and laboratory tests, this article outlines some of the problems and makes suggestions for improved control performance.

A native of Toronto, Frank Watson is engineering supervisor in central Canada for Honeywell Controls, Limited, commercial division sales. After serving 4 years in the Canadian army as a radar engineer during World War 2, Frank attended the University of Toronto, graduating with honors in 1949 with a mechanical engineering degree. He joined Honeywell that same year. Married, Frank has four boys — almost enough for a Canadian hockey team.

Increased Insulation

This is mentioned first, both because of its importance and the fact that it is often overlooked.

For economic reasons an electrically heated building requires more thermal insulation of walls, ceilings and windows. With this thick blanket of insulation, maximum heat loss occurs at night and only a few times each winter on exceptionally cold days. At other times the control system must cut back the radiation heat input to equal the heat losses.

The balance between radiation input and building loss is upset by internal heat gains from people, lights and machinery, and sunlight streaming through windows, reducing the heat input requirement.

Such internal heat gains take on greater magnitude with electric heating, since heat loss is kept to a minimum by the thick insulation. In some rooms internal heat gains will provide all the heat required even on cold days. In schools, for example, this situation can occur on sunny days when outside temperature is zero degrees or lower. Cooling, therefore, would be required when the outside temperature went above zero.

Some areas with no exposed walls—such as the center core of an office building—require cooling at

all times to remove internal heat gains. As long as the outside temperature is below 60 deg F, cooling required for such overheated areas can be supplied by a ventilation system. Mechanical refrigeration is required, however, when the outdoor temperature goes above 60 deg.

In a building without mechanical cooling, once the electric heating is off, the control system can do nothing to correct overheating. And the overheating is greatly accentuated when thermal insulation is increased.

Electric Heat Controls

Three forms of control are available for electric heat: two-position (on-off), multiple step (several on-off stages in sequence), and modulating.

The first two are widely used with electric heating. Modulating control, to date, has mainly been used on special applications such as test laboratories. Its limited use in other areas has been due to its higher cost and because its availability has not been known. However, there are many applications where modulating control must be used to meet quality heating standards.

Two-Position Control

A two-position unit-mounted thermostat is sometimes located in the electric radiation cabinet to sense air temperature below the heating coil (Fig. 1). Substandard performance will result for a number of reasons: the location is inadequate for measuring representative room temperatures; the thermostat lacks heat anticipation to provide faster cycling; it will be affected by radiant heat from the coil; the large-mass sensing bulb has a slow response and it is difficult to adjust the thermostat setting.

A wall-mounted thermostat (Fig. 2) will give improved performance due to its proper location and ease of adjustment. Other factors, however, can limit the effectiveness of this application. Accuracy of temperature control varies as heat anticipation either is not included or is derived from the switch; the accuracy will vary with the size of the heating element.

While some types of thermostats are designed to correct for radiant heat, it must be remembered that baseboard and convectors have little radiant output. This type of thermostat cannot be used with a magnetic contactor since the slow-moving contacts will not hold in the contactor, resulting in chatter.

A low-voltage wall-mounted thermostat with a silent mercury switch relay (Fig. 3) provides the best results. Heat anticipation is not a function of the electric load and therefore its rate can be adjusted as required.

Other models are available for electric heat systems with the cycling action increased to a maximum 30 cycles an hour. The increased cycling will help reduce cold-air stratification that occurs during the off cycle and is prevalent with low-mass electric heat radiation. This thermostat is unaffected by stray radiant heat in the room and can be used to control magnetic contactors for large loads.

Applications of Two-Position Control

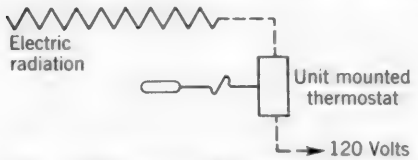


Fig. 1. Unit mounted thermostat is sometimes located in electric radiation cabinet, but the author has reservations.

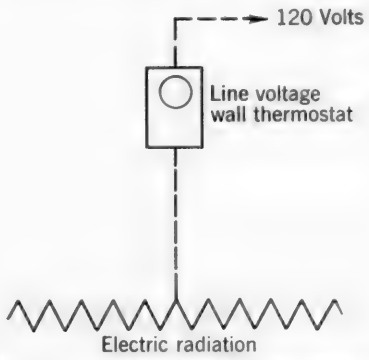


Fig. 2. A wall mounted thermostat will give improved performance due to location, ease of adjustment.

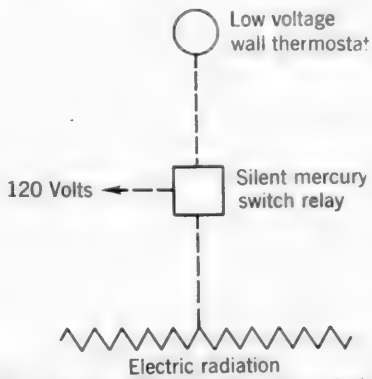


Fig. 3. Low voltage wall mounted thermostat with mercury switch relay is called best approach.

Multiple Step Control

A step controller, as shown in Fig. 4, can control sequence stages of electric heat. A pneumatic- or electric-type modulating thermostat and motor operate the step controller to bring on stages of electric heat in sequence.

Performance is improved as the number of steps is increased. Ideally, with a very large number of steps, full modulating control would result.

Applications of Multiple Step Control

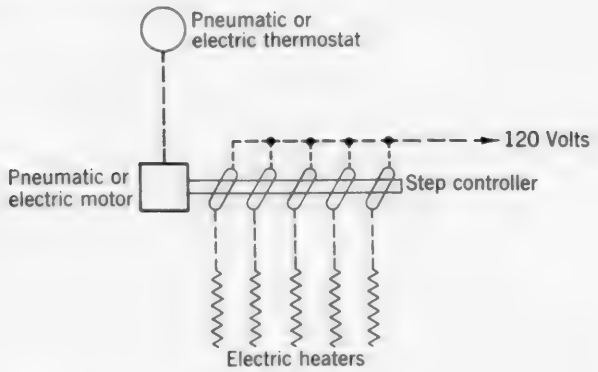


Fig. 4. A step controller can control sequence stages of electric heat. Performance is improved as number of steps is increased.

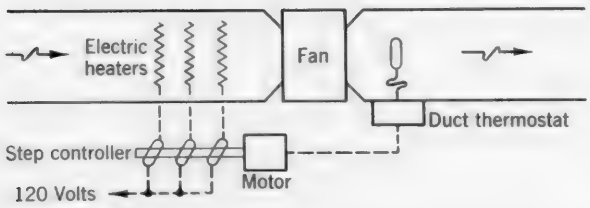


Fig. 5. Step control is sometimes used but not recommended for a central fan system where downstream duct temperature must be controlled.

Step control is not recommended for a central fan system where it is required to control the duct temperature on the discharge side of the electric heat coil (see Fig. 5). Examples include outside air ventilation systems and hot and cold duct air-conditioning systems with discharge control. Even with modulated hot water and steam coils, it is necessary to set an extremely wide throttling range on the discharge controller (normally 15 to 20 deg) to obtain stability and prevent hunting. Since a step controller has only a few control positions this throttling range will, of necessity, be much greater. Further, the immedi-

Applications of Modulating Control

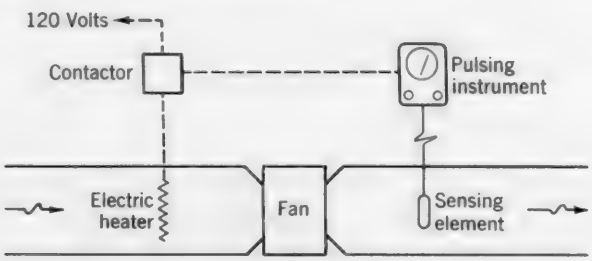


Fig. 6. Variation of effective wattage is satisfactorily but noisily achieved by adjustable cycle time control instrument which operates contactor on electric heaters.

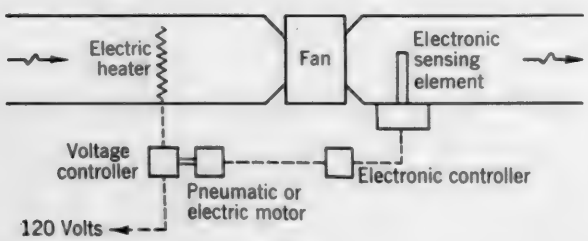


Fig. 7. Varying voltage has been used in several forms (described in text) with good success to modulate electric heat.

ate response of the thermostat due to its location causes frequent cycling between stages. This reduces the life of the switches or magnetic contactors. In such cases the electric heating coil should be modulated.

Modulating Control

A method has been used where variation of effective wattage is achieved by an adjustable "cycle time" control instrument, which operates a contactor on the electric heaters (Fig. 6).

A pulsing instrument cycles the heaters on a short total on-off time cycle. For example, with a 10-second time cycle and a small heat requirement the heaters would cycle at 1 second on and 9 seconds off, while with heavier loads the control system would adjust to 8 seconds on and 2 seconds off, and so on.

While performance has proven satisfactory this has found limited use to date. For one thing, contactor life has been reduced by the frequent cycling, meaning high maintenance costs. The contactor also has proven objectionably noisy in operation.

Varying voltage has been used in several forms with good success to modulate electric heat. As shown in Fig. 7, an electronic sensing thermostat and control panel operate a modulating pneumatic or electric motor which is arranged to adjust the output of a variable voltage regulator.

Voltage variation is possible using any of the following as the final device in the control system:

1. Continuously variable auto transformer: the the most extensively used method to date.
2. Induction regulator: extremely versatile and has been used for special applications.
3. Saturable reactor: has been used for industrial purposes.
4. Silicon rectifier: a simple and small-size device lower in cost than a saturable reactor.

Results have been equal to standard modulating control. Properly applied, the components have met the requirements for durability and service. Heat distribution is uniform across the duct and problems of coil freeze-up are eliminated. Additional examples, in which modulating voltage control is desirable and limited only by economic factors, are as follows:

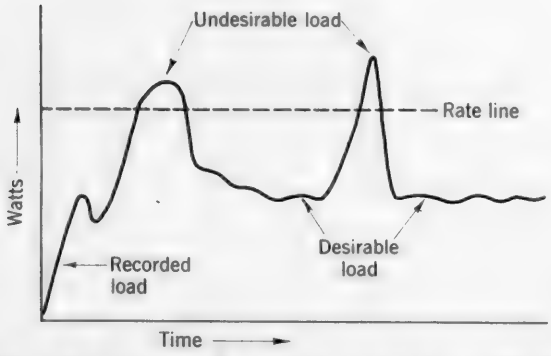


Fig. 8. It is economically desirable to prevent overshooting average peak load requirements, and there are controls for this purpose.

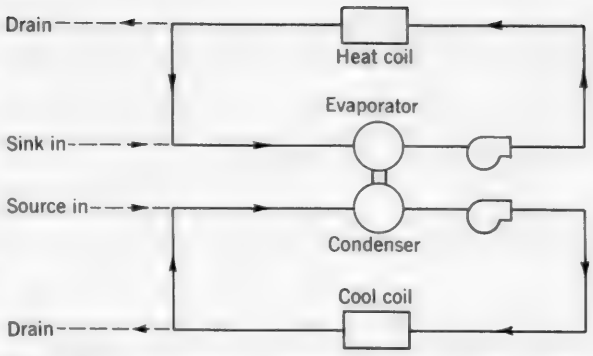


Fig. 9. The heat pump is another form of heating where electricity plays a major role. Control usually requires special consideration.

1. Control of space heating, using radiation or duct reheat coils.
2. Base load control of radiation by decreasing the voltage to supplement two-position room control.
3. Off-peak heating. This is especially suited to the "factory-office" building.

Peak Load Controllers

A basic rate for electricity may be charged according to the maximum or peak load sustained for a fixed period—say, 15 minutes. It is therefore desirable to prevent overshooting the average peak requirements (shown on Fig. 8 as undesirable load).

A simple on-off load control, available from electrical equipment distributors, consists of a relay which drops out when the peak is exceeded. In turn this temporarily removes a preselected section from the heating circuit to reduce the overall load. This method is limited by the length of time the peak might be exceeded. If it is long, auxiliary heating is necessary for areas cut off from electric heat.

Modulating peak control is achieved by using an industrial proportioning potentiometer to keep the supply voltage and, in turn, the total wattage below the selected peak. Its advantage is that partial heat is available and evenly distributed. Care must be taken in design to insure that no electrical equipment on a circuit with varying voltage will be affected by the reduced voltage.

Similarly, this peak control instrument may operate a multiple-step controller to turn off a series of preselected sections from the circuit.

The industrial peak load controller can also be used to utilize off-peak current to provide economical heating, as consumption rates only apply. A "factory-office" building combination might have several electrically operated process furnaces that use their maximum power for short periods only. The building heating system could be supplemented by electric heat up to the peak while taking advantage of the low rates. For example, in an existing building with a hot-water system, elements can be installed in the boiler. These heaters may be modulated or brought on in several stages during off-peak periods.

Heat Pumps

The heat pump is another form of heating where electricity plays a major role. Although the electrical Btu's are not directly used to heat space, they provide the force to move heat from a low temperature "source" (water or air) to the hot water or hot air medium used to heat the building (Fig. 9).

Noteworthy is the high coefficient of performance —often around 4 to 1. This means that 4 Btu's can be transferred from the source of the heating medium for 1 Btu of electrical energy operating the refrigeration compressor.

Since the commercial building is commonly cooled during the summer months, this same refrigeration compressor can be used to provide heat for winter operation. The completely automatic system can be designed to provide both hot and cold mediums simultaneously, so that different areas can be heated or cooled at any one time. This condition exists in many commercial buildings where central areas may require cooling during times when the outside areas may need heat.

If a heat source is not available or economical, it is still possible to use the heat pump as a heat-reclaim system. The central core of the building and the exhaust systems remove heat which can offset at least a part of the heating requirements.

Commercial pneumatic and electric controls are used to control the standard heating and air conditioning equipment throughout the building. Control of basic heat-pump circuits usually requires special consideration. On larger jobs industrial-type controls have been used.

Pneumatic versus Electric Controllers

In general, both pneumatic and electric controls are equally suited to control electric resistance heating. In the following cases, however, one might be better than the other.

Two-Position Radiation Control

Electric control is recommended using the low-voltage room thermostat to cycle the silent mercury switch relay (Fig. 3). The close differential and fast cycling action resulting from heat anticipation gives a more even heat output from the radiators and minimizes the stratification of cool air during the off cycle.

Unit Ventilator Control

Pneumatic control is recommended. The advantages of pneumatic control on unit ventilators also apply to units with electric coils. See Fig. 10.

The pneumatic system allows the room thermostat to have complete control of the damper for cooling and the step controller for heating at all times, with the discharge controller acting as a snubber or stabilizer.

Another advantage of pneumatic control is its simplification of unit ventilator operation during the night cycle. Here the thermostat controls at a lower temperature and cycles the fan like a forced flow heater.

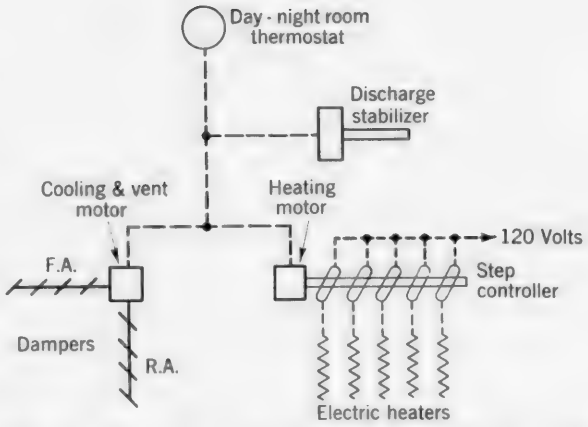


Fig. 10. Pneumatic control is recommended for unit ventilators. Text tells why.

A wall-mounted thermostat in a room is better than one mounted in the unit. The wall has proven to be the best control location for individual room control, especially since the unit-mounted controller has almost no air movement across its sensing element during night cycle when the fan is off.

When to Use Electronic Sensing

Electronic sensing offers advantages on both pneumatic and electric control systems. It features fast response and accurate sensing. The control element consists of 500 ohms of fine temperature-sensitive wire which can be coiled into a small room thermostat, or extended to a 27-foot-long element of a duct controller. Readjustment of control point setting from an outside controller is simply and accurately attained, while all adjustments can be made at a central location.

Electronic sensing is especially recommended for controllers located in ducts, controllers reset from outside temperature (master-submaster) and rooms that have a fast rate of air movement.

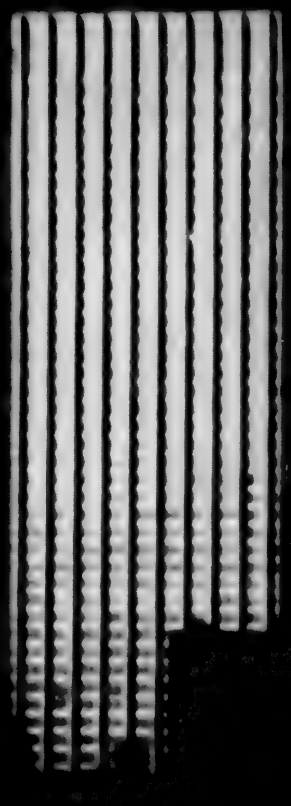
Supervision by Control Manufacturer

Commercial buildings normally include in the specifications that the control equipment be installed by the control manufacturer. This practice should be followed with electric heating.

With installed contracts the manufacturer accepts full responsibility for the control system. Formal control schematic drawings are provided and the system is set up, adjusted and guaranteed in the field for a one-year period.

Conclusion

For commercial buildings, electric heating control equipment is available for high-standard performance. The design engineer should try to specify the most suitable equipment, thereby assuring that electric heat will find its proper place as a contemporary heating method.



JAROS on office building air conditioning

Office-building

How the building facade affects costs of air-conditioning Systems —

Preliminary studies of alternate building schemes —

Preliminary studies of alternate mechanical schemes —

Details of cost estimating for boiler plant, refrigeration plant, air distribution, cooling towers, peripheral and interior zone systems —

The proper posture of the mechanical engineer toward owner and architect.

WHAT IS ECONOMIC DESIGN of services for office buildings, and what are the factors that contribute materially to it?

For our purposes, economy should be considered as relative. To the builders of a generation ago, addition of 15% to 25% to the overall costs of an office building for a type of service, air conditioning, which hitherto had not been provided, would not have been considered "economy". Today, given that we need—or want—air conditioned offices, the question becomes: which method or methods will secure the best results in a particular project at a given cost, or, alternately, which method or methods will give adequate results at the lowest cost?

Note that, in an attempt to define economy, two slightly different definitions emerge, both, in turn, depending on the definition of cost.

What Do We Mean by Cost?

Initial cost of an air conditioning system, for the purposes of this paper, includes the following:

(*a*) Cost of installing the air conditioning system itself.

(*b*) Cost of installing other mechanical or electrical services necessary to the operation of the air conditioning system, such as electric power connections, steam, fresh water and drain connections.

(*c*) Added building construction costs of supporting the weights, and absorbing vibrations or other stresses occasioned by the air conditioning system.

(*d*) Cost of providing the space and enclosures occupied by the air conditioning system and its accessory services.

The above are, properly, investment costs. Other important factors to consider are:

(*e*) Interest and taxes on investment, usually a fixed annual percentage, depending on the amount invested.

(*f*) Depreciation, or amortization of the investment, depending on the locally accepted method of computing amortization, and on the durability in both the physical sense and in that sense connoted by obsolescence, of materials and equipment. Obviously, it is more economical, if one take a long-term view, to invest a moderately greater amount for equipment that will continue to be serviceable for twenty-five years, than for equipment that might need replacement after ten years.

FRONTISPIECE PHOTO: Chase Manhattan Bank building dominates lower Manhattan skyline. Architects, Skidmore, Owings & Merrill, New York. Jaros, Baum & Bolles were the consulting engineers.

Abstracted from a paper, The Economic Design of Services for Office Buildings, presented in October at the International Conference on Heating, Ventilating and Air Conditioning, London, organized by The Institution of Heating and Ventilating Engineers. Printed by permission of The Institute.

air conditioning

ALFRED J. JAROS, JR.

Jaros, Baum & Bolles

Consulting Engineers, New York City

(*g*) Maintenance costs: cost of annual repairs and parts, preventive work, cleaning and other services needed to keep equipment in serviceable shape; all of which will vary with hours of use, types of equipment, and the care that the operators take with the equipment.

(*h*) Operating costs: annual cost of labor, electricity, steam, water and other items needed to operate the equipment.

Provided that annual costs are figured, not only on the air conditioning plant itself, but also on its accessory services and charges, including structural supports and the value of space, the sum of these annual charges taken along with the initial investment, is a much better index of relative economy than the initial investment alone.

Still other factors, varying with the nature of the project, enter into the cost picture. Two examples will suffice: The first is that an acceptably low sound level will often be demanded in spaces served, at least by the higher-class tenants. Therefore, the value of satisfactory sound levels, in fixing rentals and in maintaining public relations, is a factor meriting the most careful weighing as against the added investment needed to provide the acoustic treatment which will secure such sound levels.

Again, cleaning of buildings and their contents, cleaning or replacement of drapes and blinds, repainting of inside walls, etc., are very substantial items of building maintenance cost, about equal, in the aggregate, to operating costs of heating, air conditioning, lighting and elevator service, according to 1960 data published in *Skyscraper Management*. These costs may be affected to a considerable degree by factors in the air conditioning work, as, for example, the types and quality of air filters used, and the degree of care in their maintenance. Studies have shown that these items alone were sufficient, in some cases, to justify the use of a more efficient and more costly method of air filtration than might otherwise have been acceptable.

Many other examples could be given; their details would vary widely with type of building, its location, and type of occupancy.

Two Owner Policies Contrasted

At this point, it would be pleasant and convenient to be able to state that the answer to all the above is to employ a sufficiently competent design engineer, give him time enough (and an adequate fee) to make a proper study of all these and similar factors, and then to trust in his ability, engineering experience and devoted care to secure the best over-all economy. Such a cliché overlooks the fact that, in addition to technical competence, wide experience, care, and enough time, the engineer must also have the courage and diplomatic skill to argue, quite forcibly, when necessary, with the owners and architects of the building, if he is to secure the best results.

A few years ago, the writer had charge, during two successive years, of the mechanical designs for two very large office buildings in the same city. Both were intended for long-term leases to high-class

tenants. Both were investment buildings intended for long-term operation by responsible owners, rather than speculations intended for a quick sale. Both, of course, were subject to the same effects of climate, sunshine, and other local conditions.

The difference in costs, in spite of these similarities, is startling. In the first building, it cost about $4.50 per rentable square foot for the installation of a good, modern air-conditioning system. In the second building, costs were about $7.50! And yet, both had the same basic schemes—steam-turbine driven centrifugal refrigerating machines with cooling towers on the roof, induction-type peripheral systems for the outside zones, separate interior-zone systems of the all-air type, and approximately the same degree of zoning, subdivision, and automatic control.

The difference in initial cost is not all. There was also a comparable difference in the annual operating cost per square foot. Needless to say, the same care, experience (and desire to do a good job) were given to both projects; if anything, more care and effort, relatively, was expended upon the one that proved the more costly.

What caused these great differentials? Mainly, the very different policies decided upon by the two sets of owners and architects. The more economical building was one in which windows were of moderate size —about 30% of the total facade areas—while the other one had the largest-size windows that could be fitted into its walls. In the "more economical" building, vertical clear spaces in the outside walls were planned to permit simple, direct, vertical runs of piping and primary-air ducts for the induction units under the windows for a distance of 15 to 25 floors in each vertical zone.

In the other building, the general building design made it impossible to provide any such space in the outside walls. This made it necessary for all pipe and duct connections for units under the windows to cross over from the interior parts of the building, in hung-ceiling spaces, at every individual floor, with a consequent vast increase in the relative amounts of sheet-metal work, piping, heat-insulation, and labor of installation, per ton of cooling effect.

Of course, the larger windows also necessitated more refrigeration and more window units in proportion to floor area. Needless to say, in each case we made comparative studies of various schemes, and strong recommendations to the clients, as to what ought to be done in the way of space conditions and other factors for economy. In the one case, these recommendations were followed to the greatest possible extent, while in the other case, all such considerations were subordinated to the type of facade and appearance desired. And the comparison so far given is only between the direct costs for the air conditioning installation; it does not take account of added structural costs, due to increasing the floor-to-floor height, to accommodate the great amount of horizontal ductwork and piping that had to run across every ceiling.

Importance of Cooperation

The above comparison may dramatize, to some extent, the large effect, upon engineering design for efficiency, of proper cooperation by owners and architects, but of course, this is equally applicable to many other factors besides those already discussed. In the aggregate of mechanical services design, there are many places where proper cooperation can save money without impairing results, such as:

(*a*) By so arranging penthouses or other roof structures that vertical exhaust and supply ducts can make quick and simple connections to their fans.

(*b*) By so designing the various floors that large ventilating or pipe shafts can run straight up and down, with a minimum of costly offsets.

(*c*) By so locating boiler rooms and machine rooms as to simplify and shorten interconnections with systems in various parts of the building.

To produce the best results, it is necessary to have a give and take between the architects, the structural engineers, and the mechanical engineers, especially during the early stages of planning, until all are satisfied that everything practicable has been done to secure a straightforward, simple set of conditions that will coordinate good building layout and appearance with a serviceable and economical mechanical plant. It may equally be borne in mind that everything the mechanical engineer is designing is only a portion of the complete building and must contribute its share to the entirety of the building project which the owners desire, and that, while he must make every reasonable effort to conform to the desired architectural layout and treatment, it is equally his duty to warn the architect and the owners whenever what they want to do may lead to mechanical extravagance.

Importance of Details

Apparently small mechanical details which can be controlled by proper specification and inspection may play a considerable part in economical results. As an example, consider a double-duct system which (at some time) needs to supply 100% of 55-deg F air and no 80-deg air. If we assume various percentages of leakage at the (closed) hot-air valve, the results are as given in Table 1.

Increasing the air supply means larger and more costly fans, ducts, coils and filters, etc. Reducing cold-air temperatures, as an alternate method, means deeper coils (more rows) and ultimately larger compressors and motors, per ton of refrigeration in use. If carried far enough, it also means wasted tonnage. It is important to select and specify air valves with a minimum of leakage when closed.

THE QUANTITATIVE APPROACH TO ECONOMY

Table 1 — Effect of Leaking Dampers

80-deg Air Leak, Percent	Percent of 55-deg Air	Temperature of Mixture, Deg F	Air Quantity for Same Result, Cfm	Cold Air Temp. for Constant Flow, Cfm
0	100	55.0	100.0	55.0
2	98	55.5	102.8	54.5
4	96	56.0	105.5	54.0
6	94	56.5	108.3	53
8	92	57.0	111.0	52
10	90	57.5	114.5	47

Table 2 — Typical HVAC Costs, New York City*

Percent Glass in Facade	Max. Demand, Tons	Very Economical Scheme ($1000 per Ton)	Average Layout ($1300 per Ton)	Costly Scheme ($1500 per Ton)
25	2100	$2,100,000	$2,700,000	$3,150,000
50	2550	2,550,000	3,300,000	3,000,000
75	3000	—	—	4,500,000

* For 500,000 rentable sq ft building with 70% peripheral area, 30% interior area. Equal quality of parts, materials, etc., is assumed for all schemes.

LET US CONSIDER, in detail, some of the many factors which make for economy or extravagance in the mechanical design of a project. There are several quite distinct ways of looking at the complex of items that may play a part.

Perhaps the first mode of approach is to determine the total quantities of cooling, heating, air delivery, etc., needed to serve the various major subdivisions of the building, as affected by such factors as fenestration, solar shading devices or methods, methods and quantities of electric lighting, concentration of population, as well as the effects of such factors on choice of air conditioning schemes. Another approach is to scrutinize the major categories of mechanical work entering into a project with a view to simplifying and better coordinating them.

To a considerable extent, the two modes of approach are interdependent and both merit the same careful study, since both materially effect investment and annual costs. Table 2, with heating, ventilating and air-conditioning data typical of New York City, helps to show this.

In Table 2, the "very economical schemes" consist of a minimum number of compressors, pumps, zones, etc., together with such careful adaptation of space conditions and structure as to require the minimum amounts of piping, sheet metal, etc., consistent with needed capacities and proper schemes. The "average layout" is similar, but with spare units where practicable, higher-grade air filtration, more zoning and flexibility, more subdivisions of automatic control, and so forth.

Table 3 — How Tonnage is Affected by Lighting, Population Densities

†Watts per Sq Ft	Supply Air Temp. Diff., Deg F	Square Feet of Floor per Person									
		20		40		60		80		100*	
		Cfm per Sq Ft	Tons per 1000 Sq Ft	Cfm per Sq Ft	Tons per 1000 Sq Ft	Cfm per Sq Ft	Tons per 1000 Sq Ft	Cfm per Sq Ft	Tons per 1000 Sq Ft	Cfm per Sq Ft	Tons per 1000 Sq Ft
3	15	1.23	4.17	0.93	3.00	0.82	2.72	0.78	2.58	0.75	2.34
6*	20	1.40	5.0	1.16	3.83	1.08	3.55	1.05	3.41	1.03	3.17
9	22	1.68	5.73	1.47	4.60	1.38	4.32	1.36	4.18	1.34	3.94
12	25	1.85	6.67	1.67	5.50	1.60	5.22	1.58	5.08	1.56	4.85
15	25	2.22	7.5	2.04	6.33	1.98	6.05	1.95	5.90	1.92	5.66

* Frequent present-day assumptions.

† In the above table, "watts per sq ft" means the electric heat actually liberated in the conditioned space—and does not include any portion absorbed into (and removed with) exhaust or "spilled" return air.

The "costly scheme" carries these details of fine design still further, with such additions as individual control for each window unit, but suffers in economy mainly from major increases in piping and sheet-metal, for instance.

Effect of Lighting and Population Density

A quite different example will demonstrate the large effects, even on interior demands, caused by heavy concentration either of population, lighting, or other electric heat source. Table 3 is based on the following reasonable assumptions:

(a)	Minimum desirable air supply	0.8 cfm per sq ft
(b)	Sensible heat per person (av.)	200 Btuh
(c)	Latent heat per person (av.)	200 Btuh
(d)	Desirable outside air	0.4 cfm per sq ft
(e)	Outside air, minimum	10.0 cfm per person
(f)	Outside air conditioning	40 Btuh per cfm

(g) 20 deg F or less desirable temperature difference between maintained and entering air temperatures for economical refrigeration.

(h) 25 deg maximum permissible temperature difference.

The exact figures in Table 3 are somewhat dependent on the assumptions used; however, the principles that the table illustrate still hold:

1. For interior zone spaces, the fairly common assumptions, of about 100 sq ft per occupant and 3-6 watts per sq ft, fit nicely into a combination of air quantities, both adequate and economical to provide, with moderate demand for refrigeration.

2. Crowding causes a moderate increase in air-handling quantities and costs, approximately 10% more for 2½ times the wattage, with correspondingly heavy increases in initial investment and operating costs.

3. Increasing electric heat load, a modern tendency, causes a much more substantial increase, pro rata, in both air quantity and tonnage, from 1.5 to nearly two times as much of both, as a result of 2½ times the wattage, with correspondingly heavy increases in initial investment and operating costs.

4. It should be remembered that, unlike peripheral zones that are influenced by the weather, the heavily loaded interior zones require cooling the year around.

How Cooling Load is Distributed

At this point, it will be instructive to visualize the proportions of total cooling demand chargeable to different factors. An evaluation may be based on any desired set of assumptions, such as:

Floor area	100 sq ft per person
Electric heat	6 watts per sq ft
Outside air	0.4 cfm per sq ft
Outside air conditioning	40 Btuh per cfm (corresponding to about 75 deg wet-bulb outside and 77 deg db, 50% rh or 79 deg db and 45% rh inside)
Percent glass in facade (with good inside Venetian blinds, or equivalent)	25, 50 and 75 (representing three separate types of buildings)

Based on the above assumptions, people and lights will give about 22.5 Btuh per sq ft sensible heat and 2.5 Btuh per sq ft latent heat. Conditioning of outside air, brought in for ventilation and pressurizing, will absorb about 16 Btuh per sq ft.

In the peripheral zone, assumed to extend 18 ft inward and directly exposed to sunshine, heat through glass will approximate 20, 40, or 60 Btuh per sq ft of floor. It will be sufficiently accurate, with average walls, to take wall conduction at 3, 2, or 1% of the total in the three cases. A miscellaneous allowance for fan heat, duct heat pick-up, and safety factors of not over 12% of the total may be made.

In the case of a sunlit facade, the writer's analysis is shown in Table 4.

If we assume four more-or-less equal facades and that 40% of the total floor area is interior zone, and that, at any given time, blinds are not drawn on the three sides not exposed to sunshine, then overall percentages for the entire building would approximate the figures in Table 5.

Since the various percentages in Tables 4 and 5 for people, lights, and outdoor air actually represent the same cooling load in all cases, it can be seen that, as window sizes are increased, the thermal load due to glass becomes, more and more, the most serious single factor in air conditioning cost—both initial cost and annual cost.

How the Facade Influences Choice of System

The foregoing dealt only with the maximum *amount* of cooling work required. As window solar heat load grows larger, the *type* of air handling scheme that will be most economical also changes. Installation costs of air conditioning multi-story buildings, necessarily a major factor in selecting the design, fall under three main heads:

Central Refrigeration Plant — Refrigeration machines and accessories, cooling towers or other source of condensing effect, condensing water and chilled-water piping and pumps, steam connections,

thermal insulation and acoustic and vibration protection all vary, depending upon location and type of plant. A reasonable figure to use would be $450 to $500 per ton of refrigeration.

"Floor Work" or Distributing Systems—Fans and drives, cooling and heating coils and connections, under-window units (where used), ducts, filters, outlets, automatic controls, exhaust ventilation, pipe connections and thermal and acoustic insulation are included in this category.

"Other Trades"—includes electric power supply and wiring, drainage and fresh-water connections, sill enclosures, and the like.

For a multi-story office building, under typical Metropolitan New York conditions, an attempt has been made to analyze the cost of installation for four schemes, as affected by relative proportion of sensible heat load from windows. The four systems are as follows:

I—Double-duct "all-air" system with controlled mixing boxes under windows for peripheral zones plus a single-duct system with some reheat for inside zones.

II—Metal radiant ceilings for cooling and heating peripheral zones plus a single-duct system for all parts of the floor, zoned by floors.

III—Fan-coil units under windows in peripheral zones plus a single-duct system with some reheat for interior zones.

IV—Induction units under windows for peripheral zones plus the same single-duct system for interior zones.

Table 4 — Cooling Load Analysis: Sunlit Facade

Type of Cooling Load	*Percent Glass in Facade*		
	25	*50*	*75*
	Percent of Total Load		
People, lights & office equipment	36	27	22
Window heat input (max.)	26	43	53
Conditioning outdoor air	23	17	14
Conduction through walls	3	2	1
Miscellaneous	12	11	10
	100	100	100

Table 5 — Cooling Load Analysis: Entire Building

Type of Cooling Load	*Percent Glass in Facade*		
	25	*50*	*75*
	Percent of Total Load		
People, lights & office equipment	32	24	19
Window heat input (max.)	32	47	57
Conditioning outdoor air	20	15	12
Conduction through walls	4	3	2
Miscellaneous	12	11	10
	100	100	100

For a 30-story building, about 300 by 80 ft in plan, with principal exposures North and South, peripheral-zone areas amount to about 10,000 net sq ft per floor. Cost estimates, worked up for the four systems considered, for each 1000 sq ft of peripheral zone area, are shown in Tables 6, 7, and 8.

In the computations for tables 6, 7, and 8, outside air, brought in for ventilation, was taken at 0.4 cfm per sq ft; outside conditions at 75 deg db, 50% rh. Under these conditions, the interior-zone net area, about 8,000 sq ft per floor, not including the core, would require, for its separate air handling system, about 3.3 tons per 1000 sq ft; 1.0 cfm total air per sq ft; about $1500 for HVAC floor work; $400 for plumbing, electrical, and miscellaneous; and $1400 for central refrigeration plant, all per 1000 sq ft; or a total of about $3300, regardless of window sizes. Obviously, combining interior- and peripheral-zone costs would bring down the overall or average figure for the entire building. For example, with 50% windows and induction units, the average would be 4.3 tons per 1000 sq ft and $5.75 per sq. ft. These are quite typical unit costs, at least for New York City.

Annual Costs

Annual or owning costs vary in a manner similar to initial costs.

Operating labor is a fairly definite quantity for a given building. Fixed charges, of course, bear a definite ratio to investment. This is more-or-less true, also, of maintenance. For a given location and climate, operating costs for refrigeration itself is in proportion to hours of use and tonnage (not maximum installed tons, but average tons in use).

Operating costs for cooling towers, filters, pumps, etc., will be about in proportion to capacity of plant and hours of use. Operating costs for fans are in proportion to air flow quantities, fan static pressures, and hours of use. A double-duct system, for example, with its greater quantity of ducted air, uses considerably more power than an induction system. Finally, operating costs for refrigeration, towers, filters, pumps, and fans are greatly affected by prevailing rates for electricity, steam or fuel, and water.

THE QUALITATIVE APPROACH TO ECONOMY

LET US EXAMINE the other approach to economical design, one based on study of the various categories of mechanical equipment and on what may be accomplished by choosing the proper amount of subdivision, the best locations for the various parts of the plant, their spatial relations, and the particulars of their interconnections.

To start, we can subdivide the mechanical work into the following main categories with their associated accessories:

1. Steam or hot water boiler plant or other heat source.

2. Refrigerating plant for air conditioning purposes, along with its chilled-water circulating system.

3. Cooling tower and piping system, or other condensing water system, with particular reference to its effect on location of machine rooms.

4. Peripheral-zone air-handling systems.

5. Interior-zone air handling systems.

(Note that items 4 and 5 may, in many cases, be further subdivided among different vertical zones. In particular, spaces on the ground floor, and perhaps in the basement or on the second floor, due to hours and type of usage, often require quite different treatment than the typical office floors above. The same may be true of restaurant, clubroom, and other special spaces on the top of a tall building.)

6. Secondary water, or steam, piping systems.

7. Interrelation between machine-room locations and economical duct and piping layouts.

8. Air filtration methods.

9. Automatic air-supply temperature and humidity controls.

10. Electric power systems for air conditioning.

Each of these merits some individual discussion.*

Boiler Plant

Typically, boiler plants are located in basements, a practice which started long ago when coal was the standard fuel, because of the relative ease of delivering coal to, and removing ashes from, the basement, and also because, in any fine building, the ground floor or second floor space was too valuable for such purpose.

Even with oil, there are practical difficulties in the way of locating boiler plants at a great height above the street, but in those parts of the world where natural gas is a preferred fuel, the radical innovation of placing the boiler plant on the roof, of even a very tall building, has sometimes proved convenient and economical. This has been particularly the case in areas where, in addition to natural gas supply, the following conditions applied:

(a) Basement space was valuable for parking or other purposes.

(b) Building was to have a large refrigerating plant for air conditioning.

(c) Because of cooling tower and fan room locations, the roof appeared to be a logical place to locate the refrigerating plant.

(d) The refrigerating plant was to be operated by steam from the boiler plant with turbine-drive centrifugal or steam absorption machines.

(e) During the winter, large amounts of steam were also required at the roof fan room, for warming air, and for secondary water to be circulated through local parts of the air conditioning system.

Under such conditions, locating the boilers on the roof, especially in a really tall building, saves both construction costs and space for a chimney, releases basement space for valuable use, and materially reduces the total cost for steam piping and other interconnections. This apparently radical innovation has proved successful in quite a number of cases. Its real lesson is, not so much to think of the roof as a boiler plant location, which would perhaps be workable only with gas fuel, but to think of the boiler plant, not as an independent entity, but as a part of the entire building project and to design it with such a location and such arrangements as will most contribute to convenience, space, economy of operation and to the economy of other mechanical features of the building.

An important consideration related to ultimate economy, including continuity of building service, is to divide the required boiler capacity into several units, usually with a moderate margin of capacity, as break-down protection against the building having to shut down for lack of steam during a critical winter period. Two boilers, each good for about 50% of the maximum demand, provided the project is large enough to make this an economical size, would be a good choice.

Boiler Plant Costs

While unit costs of boiler plant equipment will vary considerably with plant size, types of equipment, and other factors, the writer's experience indicates that about $5.00 per lb per hr of maximum steam generating capacity, plus or minus about 20% for variables, is a good average figure for the complete mechanical boiler plant equipment. If we should apply this, for example, to a building with 1000 tons of steam absorption refrigerating demand, 5000 lb per hr of summer steam demand (hot water, reheat,

* Individual discussion of some of these categories has been omitted here.—Ed.

etc.) and, say, 18,000 lb per hr of maximum winter steam demand (of which 15,000 lb per hr is space heating and air heating, after crediting the heat from minimum occupants and lighting, a simple analysis might look like this:

Max. summer steam, (1000 × 20) + 5000	25,000 lb per hr
Max. winter steam	18,000 lb per hr
Size of each of two 75% boilers	13,500 lb per hr
Size of each of three 50% boilers	9,000 lb per hr
Possible plant cost, with 2 boilers, 27,000 lb per hr total	$130,000
Possible plant cost, with 3 boilers, 27,000 lb per hr total	$142,000
With one boiler out, 2 boilers give (winter)	75% service
With one boiler out, 2 boilers give (summer)	54% service
With one boiler out, 3 boilers give (winter)	100% service
With one boiler out, 3 boilers give (summer)	72% service

Under such conditions, 3 boilers would be a good choice. The fixed charges on the extra $12,000 investment would be a reasonable "insurance premium" for protecting a building, perhaps worth $7,500,000, against all winter risks, and all but minor summer risks, of serious service interruptions.

Table 6 — Air Conditioning Costs — 25% Glass Facade*

Item	*I Double Duct*	*II Radiant Ceiling*	*III Fan-Coil Units*	*IV Induction Units*
	Per Net 1000 Square Feet			
HVAC equipment	$4300	$4300	$4000	$4350
Elev., plbg., misc.	1000	600	1460	700
Floor work cost	$5300	$4900	$5350	$5050
Tons refrigeration	4.3	4.0	4.0	4.0
Ducted cfm (S. & R.)	4500	1700	600	650
Supply cfm per ton	680	240	100	115
Cost of central plant	$1900	$1800	$1800	$1800
Total HVAC cost per sq ft (incl. foundations, elec., etc.)	$7200	$6700	$7150	$6850
Total dollars per ton	$1670	$1670	$1790	$1710

Table 7 — Air Conditioning Costs — 50% Glass*

Item	*I Double Duct*	*II Radiant Ceiling*	*III Fan-Coil Units*	*IV Induction Units*
	Per Net 1000 Square Feet			
HVAC equipment	$5100	$5100	$4200	$4550
Elec., plbg., misc.	1200	700	1400	800
Floor work	$6300	$5800	$5600	$5350
Tons refrigeration	5.7	5.2	5.2	5.2
Ducted cfm (S. & R.)	6000	3000	600	1000
Supply cfm per ton	700	320	77	120
Cost of central plant	$2500	$2300	$2300	$2300
Total HVAC cost per sq. ft. (incl. foundations, elec., etc.)	$8800	$8100	$7900	$7650
Total dollars per ton	$1550	$1560	$1520	$1470

Table 8 — Air Conditioning Costs — 75% Glass*

Item	*I Double Duct*	*II Radiant Ceiling*	*III Fan-Coil Units*	*IV Induction Units*
	Per Net 1000 Square Feet			
HVAC equipment	$5900	$5500	$4900	$5000
Elec., plbg., misc.	1400	900	1500	900
Floor work cost	$7300	$6400	$6100	$5900
Tons refrigeration	7.4	6.8	6.8	6.8
Ducted cfm (S. & R.)	7600	3800	600	1250
Supply cfm per ton	690	300	59	114
Cost of central plant	$3300	$3000	$3000	$3000
Total HVAC cost per sq ft (incl. foundations, elec., etc.)	$10,600	$9400	$9100	$8900
Total dollars per ton	$1440	$1380	$1340	$1310

* Double-Duct cfm includes 100% "cold-deck" and 60% "hot-deck" duct capacities.

Radiant Ceiling costs have been "credited" with value of standard acoustic ceiling, that might be used with other schemes.

Scheme III (under "misc.") includes unit enclosures, drainage and electric connections for units.

Scheme IV (under "misc.") includes unit enclosures.

It must be understood that these figures will vary with different proportions and orientations of buildings, as well as with locality and quality; they should be considered comparative, only.

Proper *use* of Venetian blinds, on "sunny side" windows, is assumed.

Table 9 — Approximate Costs for Central Refrigeration Plant
(based on New York City prices)

Item	*Type of Refrigeration, Drive, and Location*				
	Centrif. Motor Basement	*Centrif. Motor Roof*	*Centrif. Turbine Basement*	*Centrif. Turbine Roof*	*Absorp. Steam Roof*
Refrigeration	$165	$165	$200	$200	$170
Chilled water	200	150	200	150	150
Cooling towers	55	55	60	60	70
Condensing water	110	45	130	50	55
Drain & water	10	15	10	15	15
Steam piping	—	—	25	45	50
Mechanical	$540	$430	$625	$520	$515
Boiler capacity	—	—	80	80	100
Elec. wiring	50	90	15	45	50
Over-all	$590	$520	$720	$645	$675

Refrigerating Plant Costs

It is hardly possible to establish a general relation between boiler plant costs and tonnage of air conditioning. However, reasonably approximate unit costs can be estimated for typical refrigerating equipment. For a 30-40 story office building of good size, the writer's experience suggests some such dollar figures as given in Table 9 for the central refrigerating plant.

Table 9 is based on New York City costs, and the assumption that a major part of the total fan capacity will be either in roof penthouses, or in intermediate mechanical floors well up in the tower. Boiler capacity cost is only for the steam required for generating refrigerating effect, and boilers, if any, are in the basement. It will be seen that the availability of purchased steam, at moderately high pressure, would make the last two types much more competitive; but the selection really depends even more on relative electric and steam (or fuel) unit costs.

All figures in Table 9 are per ton of installed refrigeration. Nothing about them depends on the design of the building, except of course, the ratio between square feet of useable area, and total tons. And this relation depends very much on the shape and orientation of the building, the size of windows, how they are shaded from the sun, and other such factors, all of which play a part, therefore, in the cost per square foot of the refrigerating plant.

It may be instructive, at this point, to present a couple of comparative examples showing the influence of building shape and facade on mechanical costs.

Building *A* is a reasonably square building with 25% of glass in all facades, very good external shading, 50% of its area peripheral zone and 50% interior zone.

Building *B* is long and narrow, with 75% of its facade glass, Venetian blinds only, and 80% of peripheral to 20% of interior zones.

Table 10 compares the mechanical costs of each.

Cooling Towers

By their nature, cooling towers must be located where the large quantity of hot, humid air they discharge, and the noise of their operation, will not be objectionable. Most often, this means a location above the main roof. Although not too heavy, they are bulky and must be so supported as to make all parts accessible for inspection and maintenance. In most locations, carefully controlled chemical treatment of water is needed, to limit or prevent corrosion.

Some of the problems and possibilities of cooling towers are:

1. If the building discharges large amounts of air from conditioned spaces during peak summer weather, it will be advantageous to deliver it into the base of the cooling tower. With a wet-bulb 10 deg or so lower than ambient, such spill air will increase the capacity, or reduce the needed size, of the tower.

2. Tower design should facilitate access to all interior points.

3. Wherever feasible, interior parts should be of non-corrosive materials.

4. If the climate is such that possible freezing weather may intervene between periods when some areas may need refrigeration, the tower and its connections must be provided with adequate anti-freeze arrangements.

Peripheral-Zone Systems

Peripheral-zone systems can be most economical if one fan room can feed straight up and down the outside walls for 8, 10 or 12 floors either way. For example, in a 40-story tower, the best arrangement

would have intermediate horizonal distribution at about the 10th and 30th floors. Any set-backs in outside facades should be at the levels of such distribution, if possible. A second good arrangement would be one fan room on the roof, feeding down for about one-half the height of the tower, and a second one just below the tower, feeding up.

A third possibility would be one intermediate mechanical floor at about mid-height—feeding up and down.

Note that the second and third schemes involve vertical distribution for around 20 floors, compared to about 10 for the first scheme. This will require vertical ducts and pipes of about 1.5 times as great diameter, or twice as many of the same diameter as for the first scheme, so that cost of vertical work will be nearly doubled. Whether or not the savings from having only one set of fan-room equipment, one set of (larger) horizontal distributing duct work, etc., will balance with this, is a matter of engineering study in the individual case.

Other factors will materially affect comparison of such alternatives. Tall buildings generally require intermediate elevator machine rooms, intermediate water tanks or heaters, and intermediate horizontal water piping distribution. If the floor where these various services are accommodated can be the same one which accommodates the intermediate fan room and horizontal ducts, large economies in structural cost and cubage results and this may prove the determinant in choosing between air conditioning schemes.

The most extravagant scheme, as previously implied, is one in which vertical conduit ducts and piping cannot be placed in outside walls—so that they must run out horizontally, from the shafts in the core, at every floor.

Interior-Zone Systems

Interior-zone systems, at least in the better-class buildings, will require some temperature control as between different floors and may require this in certain cases, even as between different parts of the same floor. Again, several schemes are possible:

(a) The simplest and least costly to install, but the least flexible: At each general fan-room level, an interior-zone fan rig feeds up, down (or both) via a duct in a central shaft in the core. The system is sized for the total CFM for all floors served. At each floor, a duct branch, usually at moderately-low pressure and velocity, comes out and distributes horizontally to suitably-placed ceiling outlets of appropriate capacities.

(b) The above, typically, would be a low-pressure system throughout. The first improvement would be to operate the vertical system at several inches, water-gage, of pressure, and provide a reducing valve, preferably followed by a sound-attenuator, for the horizontal feed-out on each floor. This adds a moderate cost, especially if the central system is moderately over-sized, but provides much greater flexibility; varying needs of tenants on different floors can be adjusted for, over a considerable range.

(c) A further improvement, often used, will provide a reheat coil, with a capacity to warm the air 25 to 35% of the maximum temperature differential, for each floor, controlled by a thermostat either at a central location or in the main return duct from that floor.

(d) In a building with very large individual floor areas, and particularly if these are apt to be subdivided between different types or densities of occupancy, this last scheme may well be subdivided correspondingly. Each of the several major areas is served by a separate set of reducing-valve, reheat coil, and sound attenuator, all, perhaps, deriving their air primarily from the same vertical system.

(e) Reheat may be accomplished electrically (cheap to install, but usually expensive to operate), or by means of steam, or circulated hot-water. The last-named is most easy to graduate.

(f) A quite different method, sometimes worthwhile, is to run a vertical double-duct system, with each floor or major subdivision thereof fed through mixing-valves and sound attenuator. This scheme may cost somewhat more to install, but has several advantages in a large building:

I. While giving excellent zone control, it eliminates the operating cost of reheat, which includes over-cooling such air as is afterward reheated.

II. It provides the ultmost of flexibility.

III. If important private rooms or other special spaces must be served on any individual floor, the double-duct system itself may be extended around all or any part of that floor, with individual mixing-box control for each such space.

IV. All such variations remain available, as tenant-changes, even long after the completion of the building.

Automatic Controls

Automatic controls are too big a subject for very detailed discussion here. It is possible to provide any degree of control that the type of system can use, and

Table 10 — Mechanical Cost Compared

Item	*Building A*	*Building B*
Tons of refrigeration per 1000 sq ft of perimeter space	3.6 (50% of area)	7.0 (80% of area)
Tons of refrigeration per 1000 sq ft of interior space	3.2 (50% of area)	3.2 (20% of area)
Tons of refrigeration per 1000 sq ft of entire area (average)	3.4	6.24
Cost of refrigeration plant @ $600 per ton	$2040	$3740
Cost of perimeter induction system	2500	4740
Cost of interior zone system	940	370
Mechanical total cost per 1000 sq ft	$5600	$8850

that the occupants find useful, but the engineer must exercise his judgment, always, in arriving at the best compromise between extravagance and inadequacy. From much experience, the writer would recommend:

(a) Automatic temperature and humidity control of the general air-supply to interior zones.

(b) Automatic temperature control with reheat, mixing, or occasionally moderate volume-reduction, for the individual floors or major parts of floors.

(c) For peripheral zones, zone control of primary air and secondary water or, under special conditions, both, for each major orientation.

(d) Within such zones, for open spaces, one thermostat for each 3-6 units.

(e) For private rooms, one thermostat for each room.

It must be understood that, in this field, as in that of thermal and acoustic materials, judgment, experience, and intelligent appraisal of the demands of probable occupants are more important than arithmetic. It is almost impossible to satisfy all of the people, all of the time. How nearly one can afford to approach the ideal is a matter for trained judgment.

Operating Economy

There is a third aspect from which air conditioning relative economies must also be examined—operating and maintenance costs—which will vary greatly with latitude, climate, sunshine conditions, usage of building, etc. and which probably should include a factor for the effects on other phases of building maintenance. Considerable published data indicates from about 30-34 cents per square foot of air-conditioned area as a fair average for direct operating and maintenance costs, winter and summer, for medium to large office buildings. This is roughly 18-20% of the annual total operating expense for average buildings exclusive of interest and depreciation, insurance and taxes, and alterations or repairs.

Labor, maintenance, etc., will be relatively fixed quantities for a given building but electricity and fuel (about 20-24 cents per sq ft, on the average, from the figures just quoted) will vary with the power and cooling requirements of the system and with how intelligently it is operated.

Since the HVAC installation may easily average 20-25% of the entire building investment, the fixed charges on this plant are also a serious factor in the over-all building economics.

CONCLUSIONS

Just because there are so many variable factors to be weighed in a practical case, the foregoing presentation necessarily skims among quite a few of the high points. It is not possible to present a pat set of formulae and constants from which the reader may, with ease and simplicity, determine the best scheme for any building; there is, after all, no valid substitute for experience, nor for its careful application to the problem. But perhaps enough of the more important factors has been brought out to justify at least a tentative set of conclusions.

(a) Those responsible for HVAC design should be considered a very important part of the building's design team.

(b) It should be a recognized part of their duties to advise about those features in the building design which will have an important effect on the initial and operating costs of the mechanical equipment as well, of course, as on its proper and satisfactory functioning.

(c) Such advice will often require preliminary or comparative studies of alternate building schemes, so that their work should start well before the building schematics are crystallized.

(d) In addition to this advisory function, they should work out, and compare, different equipment and mechanical system schemes as to their relative space requirements, results, investment cost, and cost and ease of operation and maintenance.

(e) This second stage of studies should lead to further advice on building layout—shaft and machine-room locations and space-requirements, etc., shafts and other spaces needed for duct and piping distribution, and the like.

(f) After there has been a complete meeting of minds on all preliminary points, the preparation of contract plans and specifications must embody all decisions and accepted schemes, so clearly defined and in sufficient detail that there will be no ambiguity in the minds of bidders or contractors and no difficulty in requiring them to provide the satisfactory plant which the engineer intended to design and obtain for the owner.

All of which implies:

1. The engineer must have adequate knowledge, ability, and experience to suit the size, character, and scope of the project.

2. He must have the character and forcefulness to fight for the good of the project when necessary, even against his client.

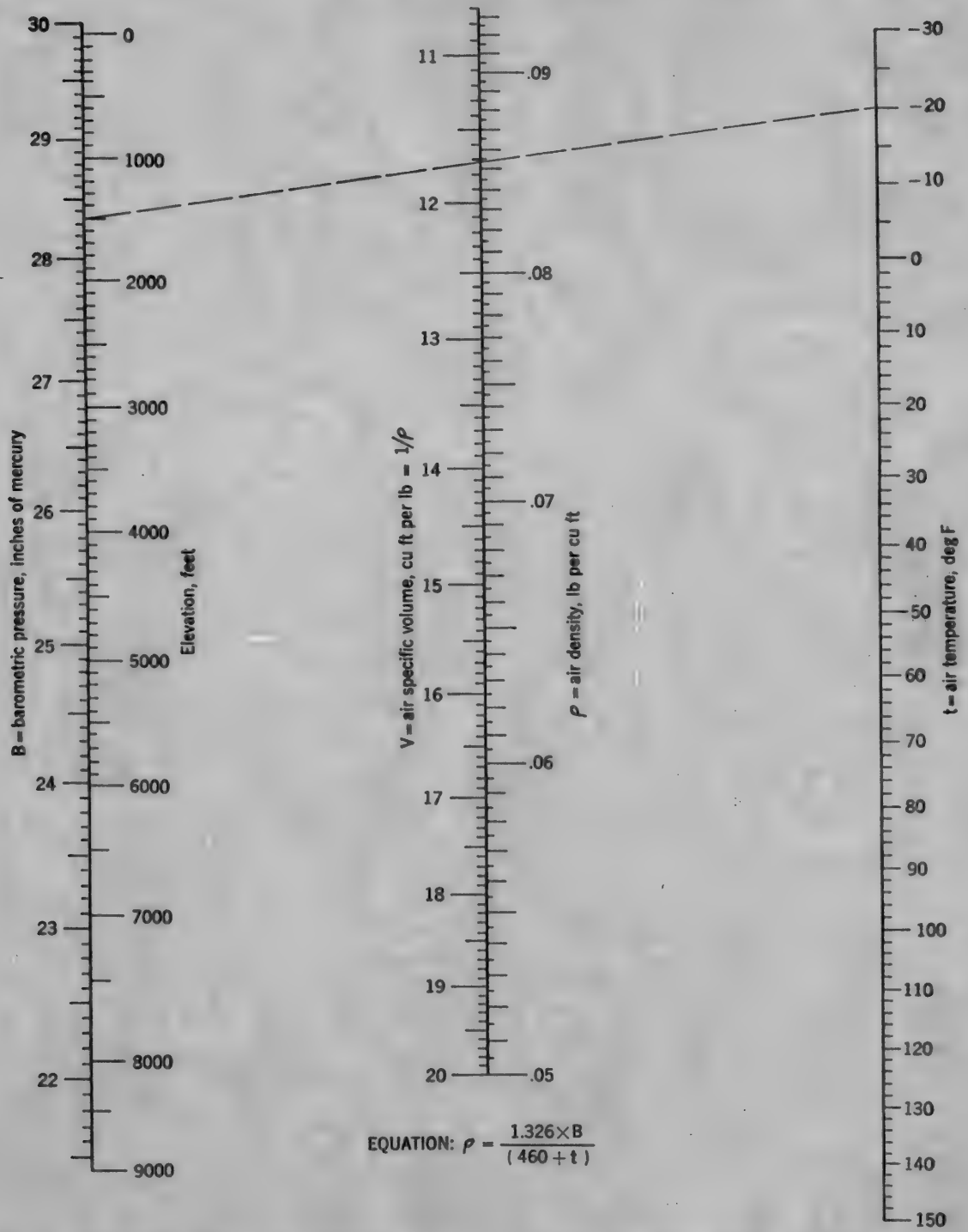
3. He must also have the tact, logic, and imagination to present cogent arguments in support of his recommendation and to work out reasonable compromises with architectural and structural considerations, when needed for the over-all best interests of the project.

4. During construction, he must cooperate with builders and subcontractors to secure a good job, but not accept short-cuts or compromises that will impair operating results, good maintenance, or proper life of the plant.

One more corollary. The engineer must insist on enough time and a sufficient fee to enable him to give his client all the service the project deserves. There is nothing more short-sighted than to spend a million dollars or more on a plant that could have been thoroughly satisfactory if only two months' more design time or a few thousand dollars more in fees had been devoted to making it so.

NOMOGRAPH FOR FINDING DRY AIR DENSITY

(At various altitudes and temperatures)



The nomograph above was designed by F. Caplan, Kaiser Engineers, Oakland Calif., a division of Henry J. Kaiser Company, for finding the density of dry air at various altitudes and temperatures.

Example: If plant elevation is 1500 feet above sea level and outside air temperature, t, is -20 deg F, what is ρ, the air density?

To find the answer, align $t = -20$ with Elevation $= 1500$ and read $\rho = 0.0853$ lb per cu ft.

EXPANSION LOOPS FOR COPPER WATER TUBE

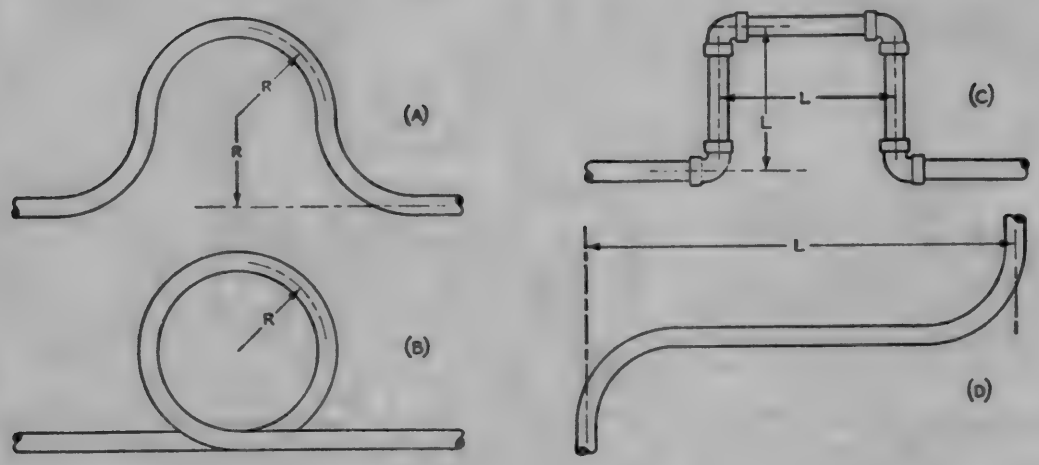


Table 1—Coiled Expansion Loops

Expansion, Inches	Standard Tube Size—Inches								
	¾	1	1½	2	2½	3	3½	4	5
	Values for R in Inches								
½	7.5	8.5	10.5	12	13.5	15	16	17	19
1	10.5	12	15	17	19	21	22.5	24	27
1½	13	15	18	21	23.5	26	28	30	33
2	15	17	21	24	27	29.5	32	34	38
2½	16.5	19	23.5	27	30	33	36	38	43
3	18	21	26	29.5	33	36	39	42	47
3½	19.5	22.5	28	32	36	39	42	45	50
4	21	24	30	34	38	42	45	48	54

Table 2—Expansion Offsets

Expansion, Inches	Standard Tube Size—Inches								
	¾	1	1½	2	2½	3	3½	4	5
	Values for L in Inches								
½	43	50	60	70	78	86	93	100	110
1	61	70	86	99	110	120	130	140	157
1½	75	86	105	121	134	147	160	172	192
2	86	99	121	140	155	170	185	200	222
2½	96	110	134	155	175	192	207	222	248
3	105	120	147	170	192	210	227	242	272
3½	114	130	160	185	207	227	245	261	293
4	122	140	172	200	222	242	261	280	312

The effects of thermal expansion may be offset in copper water tube installations by installing offsets, "U" bends, coiled loops and other arrangements in the tube assembly. These specially shaped tube sections are intended to take up thermal expansion or contraction without excessive stress. Standard sized loops have been designed for the most commonly used tube sizes.

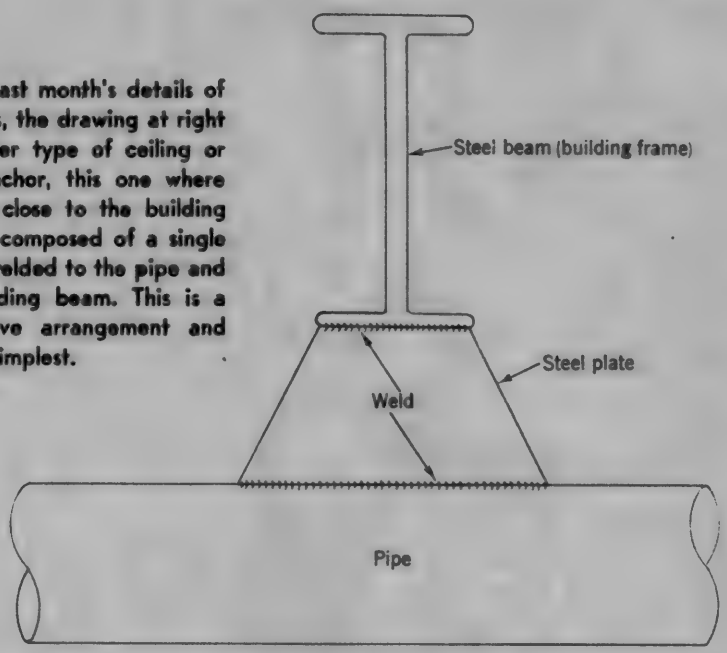
The drawings illustrate four of many possible tube arrangements which can offset dimensional changes. Types ***A***, ***B***, ***C***, and *D* can be used with either soft or hard temper assemblies. Type *C*, with soldered fittings, is most adaptable to hard temper assemblies. For horizontal runs the loops should be above the line to avoid possible entrapment of foreign matter in the liquid.

Tables 1 and 2 give values for the radii and lengths indicated on the drawings. Interpolation can give nearly exact measurements. (Text and tables, courtesy of Bridgeport Brass Company.)

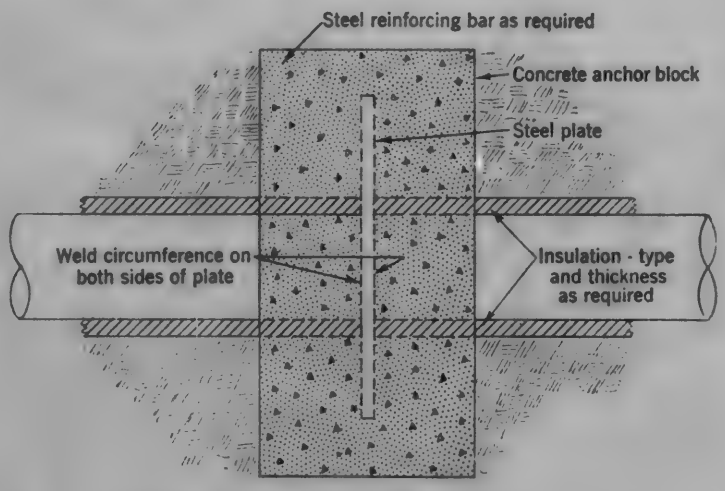
THE ANCHORING OF PIPE LINES

Ceiling or Side Wall Anchor; Underground Anchor

Continuing last month's details of pipe anchors, the drawing at right shows another type of ceiling or side wall anchor, this one where the pipe is close to the building frame. It is composed of a single steel plate welded to the pipe and a steel building beam. This is a very effective arrangement and one of the simplest.



CEILING OR SIDE WALL ANCHOR
(Where pipe is close to building frame)

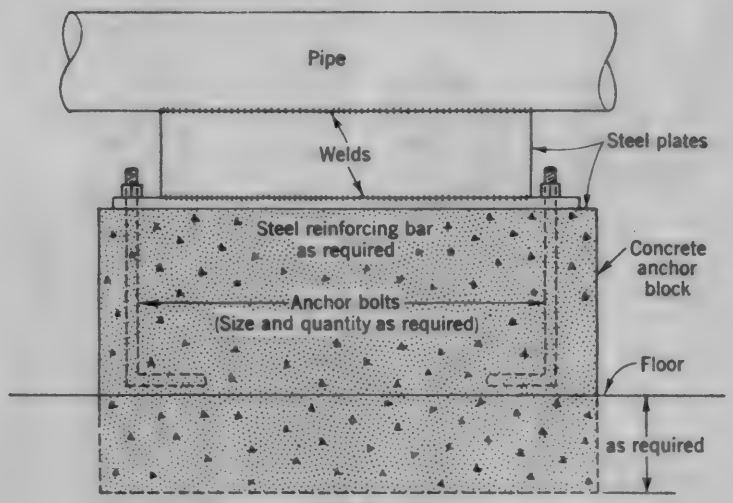

Steel reinforcing bar as required
Concrete anchor block
Steel plate
Weld circumference on both sides of plate
Insulation - type and thickness as required

UNDERGROUND ANCHOR

Diagram at left indicates how a concrete block can serve as an underground anchor. A steel plate is positioned over pipe and welded to pipe on both sides along full circumference. Pipe, insulation and plate are then encased in a poured concrete block.

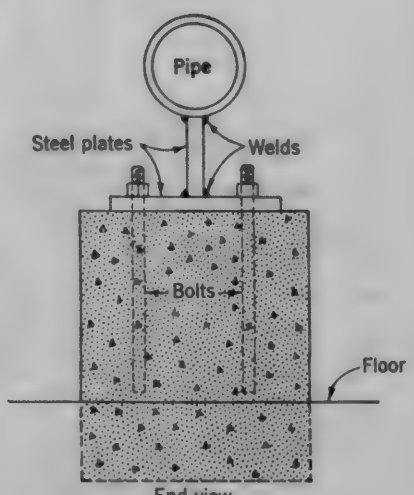
THE ANCHORING OF PIPE LINES

Simple Floor Anchor



Side view
FLOOR ANCHOR

These drawings show side and end views of a simple floor anchor serving smaller pipe lines run close to the floor. Anchor consists of two steel plates welded at right angles. Vertical plate is welded to the pipe, and horizontal plate is bolted to a reinforced concrete pier.



End view

Prepared by William L. Sculthorpe, Jaros, Baum & Boles, New York, N. Y.

ESTIMATING

Job Time Reference Data

Part 8 in this series on estimating continues the publication of a group of tables containing specific estimating data in terms of man-hours of labor. Covered this month are duct weights, erection time, and insulation requirements.

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THE FOLLOWING TABLES show the base fabrication and erection time in man-hours for the erection of standard ductwork. These are, generally, minimum base labor rates, and should be modified according to local job conditions.

Shown also are the weights of fabricated duct by the linear foot and the weights of "A" and "B" fittings, "A" standing for standard fittings and "B" for rectangular fittings.

The weights given include the necessary laps and reinforcing, plus the necessary band iron for hangers shown by the following: 24 gage 6%, 22 gage 3%, 20 gage 8.6%, and 18 gage 6.5%.

If standard reinforcing is required for duct work shown in Classes 4, 5 and 6, add 12%, 17% and 12% respectively to the weight of ducts for angles. For each 100 lb of angles add 4.0 man-hours to the base fabrication time.

Weights of duct work are shown up to lengths of 100 ft. To find the weight of duct, locate the weight shown for the semi-perimeter under the overall length of duct, or duct plus fittings. Thus, from Table 31, a duct run 6 inches x 12 inches x 50 ft overall would weigh 215 lb.

Shown also are the square feet of insulation required to cover a linear foot of ductwork. To find the square feet of insulation needed to cover the ductwork described above, we multiply the length of duct by the square feet of duct shown for the corresponding semi-perimeter size. Thus, a duct 6 inches x 12 inches x 50 ft covered with 1-inch insulation would amount to 50 x 3.4 sq ft = 170 sq ft. For 2-inch insulation, the amount would be 50 x 3.7 sq ft = 185 sq ft.

The author wishes to express his appreciation to Carrier Air Conditioning Co., Syracuse, N. Y., for permission to publish the following tables as part of his series on estimating.

TABLE 31 — GENERAL ESTIMATING DATA FOR CLASS 1, 2 AND 3 DUCT MADE OF 22 AND 24 GAGE SHEET METAL

Class 1

Ft Duct or No. Fittings			1	2	3	4	5	10	20	30	40	50	100	Insulation (sq ft per ft duct) thickness 1"	Insulation (sq ft per ft duct) thickness 2"
Base Fabrication and Erection Time in Man-Hours															
Fab. "A" Fittings			.45	.9	1.4	1.8	2.3	4.5	9.0						
Fab. "B" Fittings			1.13	2.3	3.4	4.5	5.7	11.3	22.6						
Fab. Duct			.4	.5	.6	.7	.8	1.1	2.2	3.3	4.4	5.5	11.0		
Erect. Duct			.2	.4	.6	.8	1.0	2.0	3.9	5.9	7.8	9.8	19.6		
Weight of Sheet Metal in Pounds															
Max. Side 4 to 19 Inches	Semi-Perim. Inches	10	2.7	5	8	11	14	27	54	81	108	135	270	2.0	2.4
		12	3.1	6	9	12	16	31	62	93	124	155	310	2.7	2.7
		14	3.5	7	11	14	18	35	70	105	140	175	350	2.7	3.0
		16	3.9	8	12	16	20	39	78	117	156	195	390	3.0	3.4
		18	4.3	9	13	17	22	43	86	129	172	215	430	3.4	3.7
		20	4.7	9	14	19	24	47	94	141	188	235	470	3.7	4.0
		22	5.1	10	15	20	26	51	102	153	204	255	510	4.0	4.4
		23	5.3	11	16	20	27	53	106	159	212	265	530	4.2	4.5

24 Gage

Class 2

Base Fabrication and Erection Time in Man-Hours															
Fab. "A" Fittings			.9	1.8	2.7	3.6	4.5	9.0							
Fab. "B" Fittings			2.3	4.5	6.8	9.0	11.3	23.0							
Fab. Duct			.9	.9	1.0	1.0	1.2	1.7	3.4	5.1	6.8	8.5	17.0		
Erect. Duct			1.0	1.2	1.2	1.2	1.5	2.1	4.1	6.2	8.2	10.3	20.6		
Weight of Sheet Metal in Pounds															
Max. Side 12 to 24 Inches	Semi-Perim. Inches	24	5.7	11	17	23	29	57	114	171	228	285	570	4.4	4.7
		26	6.1	12	18	24	31	61	122	183	244	305	610	4.7	5.0
		28	6.5	13	20	26	33	65	130	195	260	325	650	5.0	5.4
		30	6.9	14	21	28	35	69	138	207	276	345	690	5.4	5.7
		32	7.3	15	22	29	37	73	146	219	292	365	730	5.7	6.0
		34	7.7	15	23	31	39	77	154	231	308	385	770	6.0	6.4
		36	8.1	16	24	32	41	81	162	243	324	405	810	6.4	6.7
		38	8.5	17	26	34	43	85	170	255	340	425	850	6.7	7.0
		40	8.9	18	27	36	45	89	178	267	356	445	890	7.0	7.4
		42	9.3	19	28	37	47	93	186	279	372	465	930	7.4	7.7
		44	9.7	19	29	39	49	97	194	291	388	485	970	7.7	8.0
		46	10.1	20	30	40	51	101	202	303	404	505	1010	8.0	8.4

24 Gage

Class 3

Base Fabrication and Erection Time in Man-Hours															
Fab. "A" Fittings			1.45	2.9	4.4	5.8	7.3	14.5							
Fab. "B" Fittings			3.63	7.3	10.9	14.5	18.3	36.3							
Fab. Duct			.9	.9	1.0	1.0	1.3	2.1	4.2	6.3	8.4	9.5	19.0		
Erect. Duct			1.0	1.0	1.0	1.2	1.5	2.1	4.2	6.4	8.5	10.6	21.1		
Weight of Sheet Metal in Pounds															
Max. Side 26 to 30 Inches	Semi-Perim. Inches	32	8.0	16	24	32	40	80	160	248	328	400	800	5.7	6.0
		34	8.4	17	25	34	43	84	168	252	336	420	840	6.0	6.4
		36	8.9	18	27	36	45	89	178	267	356	445	890	6.4	6.7
		38	9.3	19	28	37	47	93	186	279	372	465	930	6.7	7.0
		40	9.8	20	29	39	49	98	196	294	392	490	980	7.0	7.4
		42	10.3	21	31	41	52	103	206	309	412	515	1030	7.4	7.7
		44	10.6	21	32	42	53	106	212	318	424	530	1060	7.7	8.0
		46	11.6	23	35	46	58	116	232	348	464	580	1160	8.0	8.4
Max. Side 32 to 40 Inches	Semi-Perim. Inches	38	11.3	23	34	45	56	113	226	339	452	565	1130	6.7	7.0
		40	11.9	24	36	48	59	119	238	357	478	595	1190	7.0	7.4
		42	12.5	25	37	50	62	125	250	375	500	625	1250	7.4	7.7
		44	12.9	26	39	52	64	129	258	387	516	645	1290	7.7	8.0
		46	14.0	28	42	56	70	140	280	420	560	700	1400	8.0	8.4

24 Gage

22 Gage

Ft Duct or No. Fittings	1	2	3	4	5	10	20	30	40	50	100

JOB TIME REFERENCE DATA

TABLE 32 — GENERAL ESTIMATING DATA FOR CLASS 4 DUCT MADE OF 20, 22 AND 24 GAGE SHEET METAL

Ft Duct or No. Fittings			1	2	3	4	5	10	20	30	40	50	100	Insulation (sq ft per ft duct) Thickness		
Base Fabrication and Erection Time in Man-Hours																
Fab. "A" Fittings			2.4	4.8	7.2	9.6	12.0	24.0								
Fab. "B" Fittings			6.0	12.0	18	24	30	60								
Fab. Duct			.9	.9	1.3	1.3	1.7	3.5	6.6	9.9	13.2	16.5	33.0			
Erect. Duct			1.0	1.0	1.3	1.4	1.8	3.5	7.0	10.5	14.0	17.5	35.0	1"	2"	
Weight of Sheet Metal in Pounds																
Class 4	Max. Side 18 to 90 Inches	48	48	11.6	23	35	46	58	116	232	348	464	580	1160	8.4	8.7	24 Gage
		Semi-Perim. in Inches	50	12.1	24	36	48	61	121	242	363	484	605	1210	8.7	9.0	
			52	12.6	25	38	50	63	126	252	378	504	630	1260	9.1	9.4	
			54	12.9	26	39	52	65	129	258	388	516	645	1290	9.4	9.7	
			56	13.3	27	40	53	67	133	266	398	532	665	1330	9.7	9.9	
			58	13.6	27	41	54	68	136	272	408	544	680	1360	10	10	
			60	14.1	28	42	56	71	141	282	423	564	705	1310	10	11	
	Max. Side 32 to 60 Inches	48	48	14.1	27	42	58	72	141	282	423	564	705	1410	8.4	8.7	22 Gage
		Semi-Perim. in Inches	52	14.1	28	42	60	75	151	302	453	604	755	1510	9.1	9.4	
			56	15.1	32	48	64	81	161	322	483	644	805	1610	9.7	9.9	
			60	17.6	35	53	70	88	176	352	528	704	880	1760	10	11	
			64	18.6	37	56	74	93	186	372	558	744	930	1860	11	11	
			68	19.6	39	59	78	98	196	392	588	784	980	1960	11	12	
			72	20.6	41	62	82	103	206	412	618	824	1030	2060	12	13	
			76	21.6	43	65	86	108	216	432	648	864	1080	2160	13	13	
			80	23.1	46	69	92	116	231	462	693	924	1155	2310	14	14	
			84	24.1	48	72	96	106	241	482	723	964	1205	2410	14	15	
			88	25.1	50	75	100	126	251	502	753	1004	1255	2510	15	15	
			92	26.1	52	78	104	131	261	522	783	1044	1305	2610	16	16	
	Max. Side 62 to 88 Inches	68	68	22.6	45	68	90	113	226	452	678	904	1130	2260	11	12	20 Gage
		Semi-Perim. in Inches	70	23.6	47	71	94	118	236	472	708	924	1180	2360	12	12	
			72	24.6	49	74	98	123	246	492	738	984	1230	2460	12	13	
			76	25.6	51	77	102	128	256	512	768	1024	1280	2560	13	13	
			78	28.6	57	86	114	143	286	572	858	1142	1430	2860	13	14	
			82	29.7	59	89	119	149	297	594	891	1188	1485	2970	14	14	
			84	30.8	62	92	123	154	308	616	924	1232	1540	3080	14	15	
			88	31.9	64	96	128	160	319	638	957	1276	1595	3190	15	15	
			90	32.9	66	99	132	165	329	658	987	1316	1645	3290	15	16	
			94	34.0	68	102	136	170	340	680	1020	1360	1700	3400	16	16	

JOB TIME REFERENCE DATA

TABLE 33 — GENERAL ESTIMATING DATA FOR CLASS 5 DUCT MADE OF 20 AND 22 GAGE SHEET METAL

Ft Duct or No. Fittings			1	2	3	4	5	10	20	30	40	50	100	Insulation (sq ft per ft Duct) Thickness	
			Base Fabrication and Erection Time in Man-Hours												
Fab. "A" Fittings			5.35	10.7	16.1	21.4	26.8	53.5							
Fab. "B" Fittings			13.4	26.8	40.1	53.5	66.9	134							
Fab. Duct			.74	1.5	2.2	3.0	3.7	7.4	14.8	22.2	29.6	37.0	74		
Erect. Duct			1.32	2.6	4.0	5.3	6.6	13.2	26.4	39.6	52.8	66	132	1"	2"
			Weight of Sheet Metal in Pounds												
Class 5	Max. Side 36 to 60 Inches	98	98	28.6	57	86	114	143	286	572	858	1144	1430	2860	16.	17.	22 Gage
			100	29.6	59	89	118	148	296	592	888	1184	1480	2960	17.	17.	
		Semi-Perim. in Inches	104	30.6	61	92	122	153	306	612	918	1224	1530	3060	17.	18.	
			108	31.6	63	95	126	158	316	632	948	1264	1580	3160	18.	19.	
			112	32.6	65	98	130	163	326	652	978	1304	1630	3260	19.	19.	
			118	33.6	67	101	134	168	336	672	1008	1344	1680	3360	20.	20.	
		120	120	34.6	69	104	138	173	346	692	1038	1384	1730	3460	20.	21.	
	Max. Side 62 to 90 Inches	96	96	35.0	70	105	140	175	350	700	1050	1400	1750	3500	16.	16.	20 Gage
			98	36.1	72	108	144	180	361	722	1093	1444	1805	3610	16.	17.	
			100	37.2	74	112	149	186	372	744	1116	1488	1860	3720	17.	17.	
			104	38.3	77	115	153	192	383	766	1149	1532	1915	3830	17.	18.	
			106	39.3	79	118	157	197	393	786	1179	1572	1965	3930	18.	18.	
			110	40.4	81	121	162	202	404	806	1212	1616	2020	4040	18.	19.	
			112	41.5	83	125	166	208	415	830	1245	1660	2075	4150	19.	19.	
		Semi-Perim. In. Inches	116	42.6	85	128	170	213	426	852	1278	1704	2130	4260	19.	20.	
			118	43.7	87	131	175	219	437	874	1311	1784	2185	4370	20.	20.	
			122	44.8	90	134	179	224	448	898	1344	1792	2240	4480	20.	21.	
			126	45.8	92	137	183	229	458	916	1374	1832	2290	4580	21.	21.	
			128	46.9	94	141	188	235	469	938	1407	1876	2345	4690	21.	21.	
			132	48.0	96	144	192	240	480	960	1440	1920	2400	4800	22.	23.	
			134	49.1	98	147	196	246	491	928	1473	1964	2455	4910	22.	23.	
			138	50.1	100	150	200	251	501	1002	1503	2004	2505	5010	23.	24.	
			142	51.3	103	154	205	252	513	1026	1539	2052	2565	5130	24.	24.	
			146	52.4	105	157	210	262	524	1048	1572	2096	2620	5240	25.	25.	
			152	54.5	109	164	218	273	545	1090	1635	2180	2725	5450	25.	26.	
			156	56.6	113	170	226	283	566	1132	1698	2264	2830	5660	26.7	27.	
			160	57.7	115	173	231	289	577	1154	1731	2308	2885	5770	27.	27.	
			164	58.8	118	176	235	294	588	1176	1764	2352	2940	5880	27.	28.	
			168	60.9	122	183	244	305	609	1218	1827	2476	3045	6090	28.	29.	
			172	62.1	124	186	248	311	621	1242	1863	2484	3105	6210	29.	29.	
			176	63.2	126	190	253	316	632	1264	1896	2528	3160	6320	29.	30.	
		180	180	65.2	130	193	261	326	652	1304	1956	2608	3260	6520	30.	31.	

TABLE 34 — GENERAL ESTIMATING DATA FOR CLASS 6 DUCT MADE OF 18 GAGE SHEET METAL

Ft Duct or No. Fittings			1	2	3	4	5	10	20	30	40	50	100	Insulation (sq ft per ft duct) Thickness	
Base Fabrication and Erection Time in Man-Hours															
Fab. "A" Fittings			9.7	19.4	29.1	38.8	58.5	97.0							
Fab. "B" Fittings			24.3	46.6	72.9	97.0	121.0	243							
Fab. Duct			1.2	2.4	3.6	4.8	6.0	12.0	24.0	36.0	48.0	60.0	120.0		
Erect. Duct			2.0	4.0	5.9	7.9	9.9	19.8	39.6	60.0	80.0	100	200	1"	2"
Weight of Sheet Metal in Pounds															
Class 6	Max. Side	96	96	45.1	90	135	180	225	451	902	1352	1804	2255	4510	16.	16.
			100	47.2	94	142	189	236	472	944	1416	1888	2360	4720	17.	17.
			102	48.2	96	145	193	241	482	964	1446	1928	2410	4820	17.	18.
			106	50.3	101	151	201	252	503	1006	1509	2012	2515	5030	18.	18.
			110	52.4	105	157	210	262	524	1048	1572	2096	2620	5240	18.	19.
			114	54.5	109	164	218	273	545	1090	1635	2180	2725	5450	19.	20.
			118	55.7	111	167	223	279	557	1114	1671	2228	2785	5570	20.	20.
			122	57.8	116	173	231	289	578	1156	1734	2312	2890	5780	20.	21.
			126	59.9	120	180	240	300	599	1198	1797	2396	2995	5990	21.	21.
			130	61.0	122	183	244	305	610	1220	1830	2440	3050	6100	22.	22.
			134	63.1	126	189	252	316	631	1262	1893	2524	3155	6310	22.	23.
			138	65.2	130	196	261	326	652	1304	1956	2608	3260	6520	23.	24.
		Semi-	142	66.3	133	199	265	332	663	1326	1989	2652	3315	6630	24.	24.
			146	68.4	137	205	274	342	684	1368	2052	2736	3420	6840	25.	25.
			150	70.5	141	212	282	353	705	1410	2115	2820	3525	7050	25.	26.
			154	72.6	145	218	290	363	726	1452	2178	2904	3630	7260	26.	26.
			156	73.6	147	221	294	368	736	1472	2208	2944	3680	7360	26.	27.
	92 to 196	Perim.	158	74.7	149	224	299	374	747	1494	2241	2988	3735	7470	26.	27.
			162	75.8	152	227	303	379	758	1516	2274	3032	3790	7580	27.	27.
			164	76.8	154	230	307	384	768	1536	2304	3072	3840	7680	27.	28.
			166	77.9	156	234	312	390	779	1558	2337	3116	3895	7790	28.	28.
			168	78.9	158	237	316	395	789	1578	2367	3156	3945	7890	28.	29.
		In.	170	80.0	160	240	320	400	800	1600	2400	3200	4000	8000	28.	29.
			172	81.1	162	243	324	405	811	1622	2433	3244	4055	8110	29.	29.
		Inches	176	82.1	164	246	328	411	821	1642	2463	3284	4105	8210	29.	30.
			178	83.2	166	250	333	416	832	1664	2496	3328	4160	8320	30.	30.
	Inches		180	84.2	168	253	337	421	842	1684	2527	3368	4210	8420	30.	31.
			182	86.3	173	259	345	432	863	1726	2589	3452	4315	8630	30.	31.
			186	87.4	175	262	350	437	874	1748	2622	3496	4370	8740	31.	32.
			190	88.5	177	266	354	443	885	1770	2655	3540	4425	8850	32.	32.
			192	89.6	179	269	358	448	896	1792	2688	3584	4480	8960	33.	33.
			196	91.7	183	275	367	459	917	1834	2751	3668	4585	9170	33.	33.
			198	92.7	185	278	371	464	927	1854	2781	3708	4635	9270	33.	34.
		202	202	93.8	188	281	375	469	938	1876	2814	3752	4690	9380	34.	35.

18 Gage

It is with regret that the editors report the death of Robert J. Smith on October 18, 1961. Consequently, this will be the last installment to appear. The enthusiastic reaction to his series was most gratifying to Mr. Smith and to the editors.

How to Feed Evaporators—3

Last month, the low- and high-pressure float valves were covered. This month concludes the series of articles on expansion valves.

Constant-Pressure Expansion Valves

The constant-pressure expansion valve feeds liquid refrigerant until suction pressure rises to a preset point. The evaporator is filled with just enough liquid to permit evaporation at a rate at which the compressor can remove it without the suction pressure rising above the preset point. This assures that the suction does not rise to the point where the compressor is overloaded.

As shown in Fig. 1, this valve is very much like the superheat control expansion valve. The difference is that the pressure which acts to open the valve is atmospheric plus spring instead of being a function of the temperature at the end of the evaporator. Evaporator pressure tends to close the valve. The actual pressure is the pressure at the outlet of the valve, but it may be some other pressure, such as the true pressure at the end of the evaporator, if an external equalizer is used. The external equalizer connects the space under the diaphragm to the point desired.

Since this type of valve feeds as necessary to maintain a particular low-side pressure, it alone cannot be used to feed each of a number of evaporators forming a part of a single refrigerant circuit. If two evaporators which form a part of a refrigerant circuit were each fed with a constant pressure expansion valve, the feeding of one valve to its evaporator would result in a slowing up of the feed to the other evaporator and there would be no definite division of refrigerant between the two evaporators.

When a constant-pressure expansion valve is used to feed liquid to an evaporator, a second control is usually required because, if the loading on the evaporator is not as great as the capacity of the compressor, the valve would continue to feed liquid until it passed the end of the evaporator. Because of this, a thermostat is usually provided at the end of the evaporator to stop the compressor when the end of the evaporator falls to a predetermined temperature.

With the constant-pressure expansion valve, only part of the evaporator is usually cooled at the beginning of a cycle and the proportion of the evaporator which contains refrigerant continues to increase as the operation continues. Evaporating temperature is constant while the proportion of the evaporator cooled varies. With the other type of control described, the proportion of the evaporator cooled is approximately constant and evaporating temperature changes.

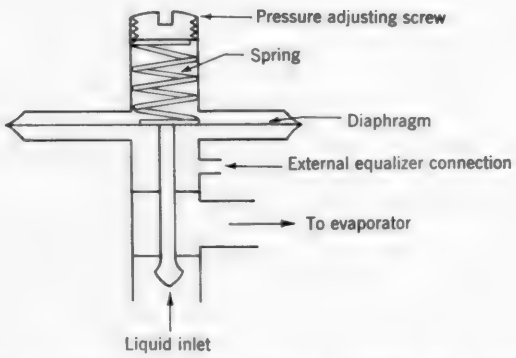


Fig. 1. Constant-pressure valve is opened by a spring.

A constant-pressure expansion valve should be used only to feed an evaporator of the type in which a change in refrigerant quantity in the evaporator results in an appreciable change in the heat absorption rate (capacity).

Choose Proper Type and Size

Given a thorough understanding of the principles of the various types of expansion valves, the most suitable one for a particular installation can be chosen. This brief discussion is in no way a complete description of expansion valves. Much more information is available in application manuals and manufacturers' bulletins. The aim, rather, is to call attention to some of the factors which are so often overlooked.

After choosing the type, it is important to size it properly. This requires a knowledge of the pressure available to pass the liquid through the valve, which depends on the pressure in the receiver or condenser and the pressure in the evaporator. Allowances must be made for differences of elevation, pressure drops through piping, strainers, driers, heat exchangers and solenoid and other valves. Pressure drop through any distributor between the expansion valve and any evaporator circuits must also be considered.

Since the evaporating pressure desired is usually nearly constant, it is evident that any reduction in condensing pressure will reduce the valve capacity.

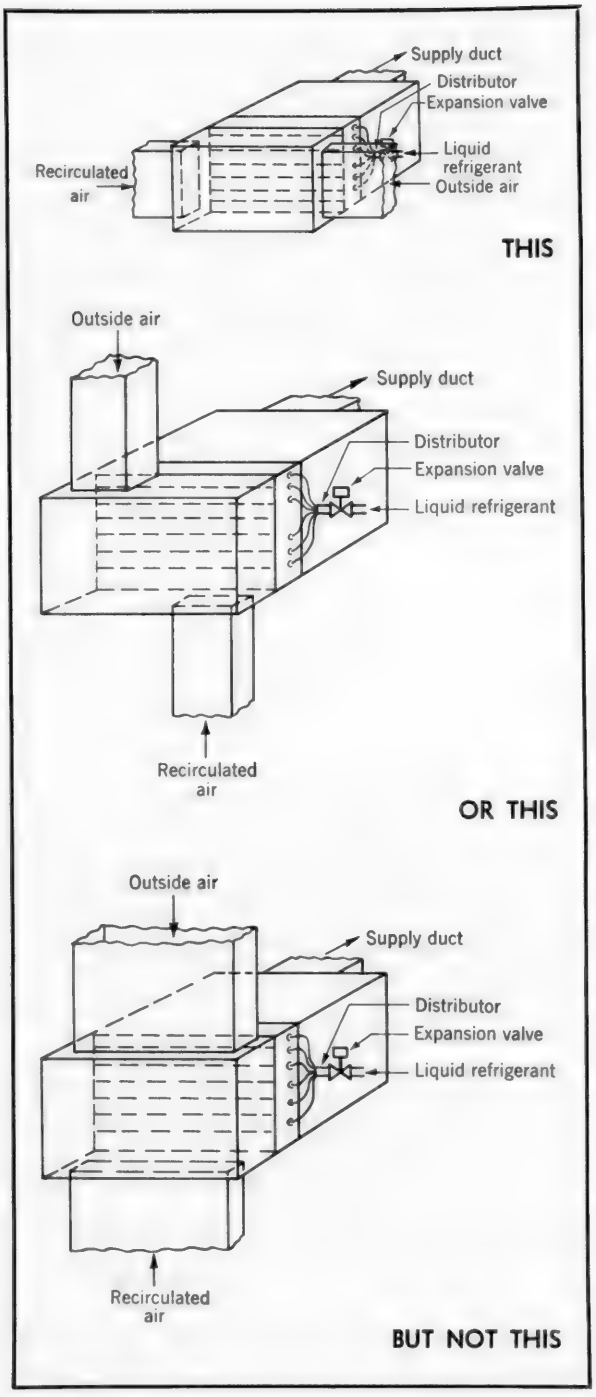


Fig. 2. Right and wrong ways to feed outside air and recirculated air to evaporator to avoid stratification.

It is therefore important that the condensing temperature be maintained above some predetermined point whenever full capacity is desired. This condensing temperature may be allowed to fall somewhat at times when full capacity is not required. In other words, the condensing pressure must be maintained above some predetermined minimum or at least controlled in accordance with the requirements of the system.

Distributors

The direct expansion evaporator commonly has several parallel circuits. In this case, it is important not only that the evaporator as a whole be fed properly but that each circuit be fed in proportion to the load it carries. It is usually not practical to have distributors feed anything but equal amounts to each parallel circuit. There are a number of good distributors for this purpose and the various manufacturers can usually be helpful in assuring their proper selection.

If loading on any one of the equally-fed circuits is low, liquid will reach the end of that circuit and reduce the expansion valve feed with the result that the higher-loaded circuits will not be fed at the desired rate. To get full capacity from the evaporator, it is desirable that all circuits fed by a single expansion valve be equally loaded. If a system has outside and return air supplies to a single evaporator, it is important that these be mixed well or that they stratify in such a way that each circuit obtains the same proportion of both. Fig. 2 shows an evaporator with several horizontal parallel circuits.

If outside air and return air come to this coil and cannot be mixed well, the outside air should go to one side of the coil and the return air to the other side and not the outside air to the bottom part of the coil and the return air to the top part of the coil (or *vice versa*). With the former division, the loading of any one circuit will be equal to the others whereas with the latter arrangement some of the circuits will have a higher loading than others with the result that the more lightly loaded circuits will control the feed to all circuits.

If the proportion of load on each circuit of a direct expansion evaporator is not predictable and constant, each circuit must be fed by a separate valve. In some cases this may result in an excessive number of expansion valves. In that case a properly designed flooded evaporator may be more desirable.

What is a Knockout Drum?

EDITOR

AIR CONDITIONING, HEATING & VENTILATING

In your August issue you had an article titled "Piping Gimmicks that Don't Work" by Melvin Ramsey. In this article the author refers to a knockout drum used in refrigeration installation. I would like to know what is a knockout drum and how it is designed into a system. We would be very grateful if you could get this information for us.

In closing, I am adding that we find your magazine very helpful and informative.

C. J. Potasek

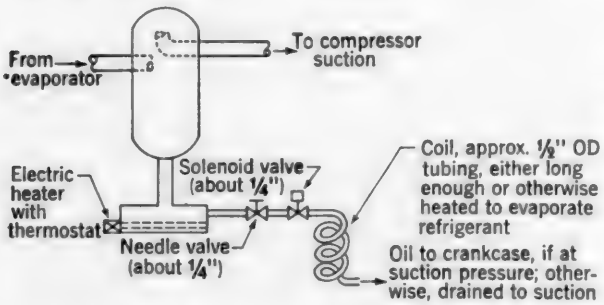
Industrial Sales Department
Minneapolis Gas Company
Minneapolis, Minn.

. . . Basically, a knockout drum is a vessel so designed as to separate any liquid from the suction gas and thus assure that liquid does not enter the compressor. Such a vessel is sometimes called by other

names, including "suction trap." Sometimes the vessel contains a heat source (possibly a warm liquid coil) to evaporate any liquid refrigerant from the oil before it is returned to the compressor or the suction line.

Knockout drums may be vertical or horizontal and have different designs, including interior baffles, to assist in the separation. I have a preference for the type of knockout drum shown in the sketch because, with its tangential entrance, it gives excellent separation and a low pressure loss for a given sized vessel.

The knockout drum is installed in the suction line so that all gas to the compressor suction goes through the vessel. The drain will contain oil and sometimes refrigerant liquid. The oil can be drained to the crankcase but means must be taken to provide heat, from the ambient or otherwise, to assure that the temperature of the drain is appreciably above saturation for the refrigerant before it reaches the crankcase. By this means, free refrigerant liquid is kept from entering the crankcase.


From evaporator
To compressor suction
Electric heater with thermostat
Solenoid valve (about ¼")
Needle valve (about ¼")
Coil, approx. ½" OD tubing, either long enough or otherwise heated to evaporate refrigerant
Oil to crankcase, if at suction pressure; otherwise, drained to suction

Sketch of knockout drum taken from Mr. Ramsey's February article, "Liquid Carryover Can Be Avoided."

The article on page 130 of the February, 1961 issue of AIR CONDITIONING, HEATING & VENTILATING discussed the liquid carryover problem. . . .

Melvin A. Ramsey
Consulting Engineer

Air Conditioning Division
Worthington Corporation
East Orange, N. J.

Asks About 3-Pipe System

EDITOR

AIR CONDITIONING, HEATING & VENTILATING

In the last few months I have had many inquiries on the 3-pipe system for both heating and cooling. I understand the basic design of this system, but was wondering if Mr. M. Ramsey could point out some of the difficulties involved in using this system.

Sales Engineer
Air Conditioning and Heating Equipment

In your letter of September 28th you mentioned the 3-pipe system for both heating and cooling. I believe you are referring to a system in which warm water is supplied in one line, cold water in another, and the return from a coil goes to a common third pipe. York has been using this system quite extensively, I believe through arrangements with the A. I. McFarlan Company, Inc. of 90 West Street, New York 6, New York. McFarlan has patents on this.

York has published a sales bulletin which describes the effect of this very well. Of course there is some waste when the water slightly above room temperature mixes with the water slightly below room temperature, as is the result when one unit is doing cooling and the one near it heating. However, this is not likely to be too great in a properly designed system and the advantages usually far outweigh the disadvantages. You could probably get considerable additional information if you communicate directly with Mr. McFarlan.

Melvin A. Ramsey

DEAR MR. RAMSEY,

I am glad to see you lower the boom on the many fair haired boys who insist on projecting pipe loops into infinity when laying out piping systems for Freon 12 and Freon 22, as you discussed in the August issue of AIR CONDITIONING, HEATING & VENTILATING Magazine.

I am just one gallus country practitioner engineer down below the Bible Belt in Georgia, but even so, I never did cotton to the "loop system" as applied in many Freon refrigerating plants.

There is a heap of folks in the refrigerating industry that are educated beyond their mental capacity, yet because of the fuddling of human reasoning, many there are who miss the boat by 40 rows of apple trees.

Then again, there are those who proceed without benefit of clergy and with the confidence of ignorance to design refrigerating and air conditioning plants and they, too, miss the boat.

I am, as stated above, glad to see you preaching the gospel of basic fundamentals and grass roots engineering. Regards.

Consulting Engineer
Atlanta, Ga.

P. S. I wonder if you are or were related to Lester A. Ramsey, formerly with York Co.?

DEAR SIR:

I was very pleased with your complimentary and amusing letter of August 19th. I might say that I don't know of any relationship between Mr. Lester A. Ramsey and myself.

When one writes some of these articles it is not too frequent to have people write in in connection with them and it is naturally a source of pleasure to the author when one does so. Thank you again for your letter and I am very happy you enjoyed the article.

Melvin A. Ramsey

The author, in this third article of his series on centrifugal pumps, shows the importance of selecting the right design in the way of mounting, type of split casing, and compares stuffing boxes and mechanical seals.

Selecting Pump Hardware

In Air Conditioning Applications

HENRY M. POLLAK
Development Engineer, Commercial Pump Department,
Ingersoll-Rand Company

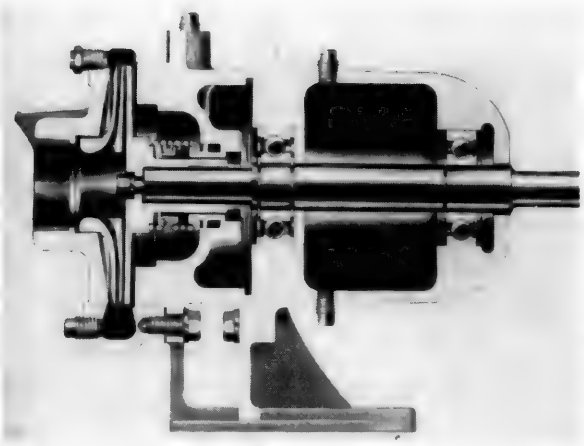


Fig. 1. The horizontally-mounted, end-suction pump shown here is usually the least expensive type.

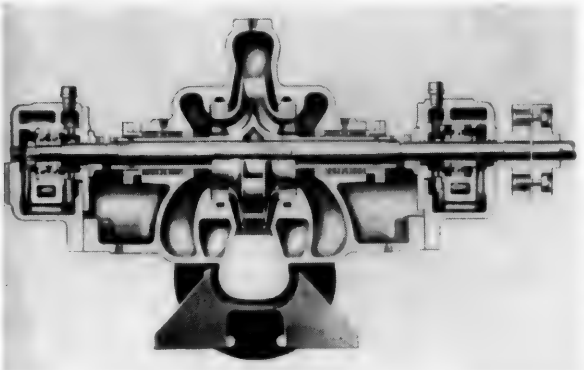


Fig. 2. The double-suction pump is recommended under three conditions described by the author.

YOU CAN TAKE YOUR CHOICE of mounting a pump right-side-up, sideways, upside-down, or anywhere in between. You can have single or double suction; close-coupled or cradle mounting; horizontally or vertically split casing; and either stuffing boxes or mechanical seals. There is wide variation in the functioning, initial cost, and operating costs of the many designs.

The question for the engineer selecting a pump to ask is, "What is the least expensive unit that will do the job and at the same time give long trouble-free service?" Normally, the least expensive pump is a horizontally-mounted, end-suction pump with a vertically-split casing, as in Fig. 1. Unfortunately, there are times when this construction will not do the job. Then, and only then, should you specify some other arrangement.

Single vs. Double Suction

Double-suction pumps, Fig. 2, are recommended under three conditions: (1) exceptionally high suction lifts (low NPSH); (2) exceptionally high specific speeds; and (3) selected conditions of high suction pressures.

Where high suction lifts are necessary, the double-suction unit, providing suction from both sides of the impeller, allows lower fluid velocities at the impeller

eye. Therefore, it inherently operates at higher suction lifts since suction losses due to the velocity head can be reduced substantially.

The double suction is sometimes applied for higher suction pressures. Axial thrust equal to the suction pressure times the area of the shaft or shaft sleeve can cause a load on the driver or support bearings. Double-suction units do not build up any unbalanced dynamic forces as a result of suction or discharge pressure as do single-suction pumps. The double-suction unit, being symmetrical about the center line of the impeller, balances the discharge pressure on both sides of the impeller. This can make it practical to specify double-suction pumps for higher operating pressures than single-suction pumps. See Fig. 3.

Split Casings

For all practical purposes, this is still a discussion between single-suction pumps with vertically split casings and double-suction pumps with horizontally split casings (although single-suction pumps are sometimes designed with horizontally split casings, they are not common in the field of heating and air conditioning).

Some claim that pumps with horizontally split casings are easier to maintain than the vertically split type, pointing out that there are no nozzles connected to the top cover, and that only the services of a mechanic are required in opening the pump for inspection. This is true if the pump requires inspection only. However, double-suction pumps are generally more difficult to assemble and disassemble; require highly skilled labor; and have an extra set of bearings, stuffing boxes and packing or mechanical seals to maintain. Although the end suction units may require a pipe fitter (and an electrician if it is close coupled), they usually can be serviced by relatively unskilled labor.

Mounting

Close-coupled pumps are the most compact and versatile units you can specify. They can operate in any position and at whatever angle provides the simplest piping arrangement and most economical installation. Cradle-mounted units with oil lubricated bearings are limited to horizontal installation. Close-coupled pumps require no base plate; they have no alignment problems; no couplings are required. Cradle-mounted units require flexible couplings between the pump and the motor shaft. Incidentally, close-coupled units are less expensive than comparable cradle-mounted pumps.

Cradle mounting is to be preferred when a particularly abrasive or corrosive medium is being pumped, or when ambient conditions are such as considerably to shorten the life of the drive unit or bearings. Motor changes and repairs can be made without breaking into the piping with cradle mounting. This is particularly useful where the future pumping requirements might vary. The motor can be changed to meet the new requirements.

There are temperature limitations to the use of close-coupled pumps. On the high end of the temperature range, 200 deg F represents a practical limit on this type of unit unless other means are provided to keep the heat from reaching the motor bearings. Where high temperature liquids are commonplace, as in the chemical and process industries, some external forced cooling device, such as a water-cooled box, cooling and flushing, injection, or even a water-cooled bearing housing should preferably be employed.

On the low end of the temperature scale, there is only one limitation of interest—pumping chilled liquid can cause condensation on the outside of the pump casing. If the back cover of the casing also forms the end cover of the motor, condensate will form inside the driver and run into the bearings and motor windings, eventually causing failure. The solution to this problem is a design that provides separate end plates for the pump and motor, thereby providing for air circulation between them. This construction is also recommended for higher temperature application (above 160 deg F) to reduce the heat that reaches the motor bearings.

Mechanical Seals vs. Stuffing Boxes

As an air conditioning and heating engineer, you should recommend mechanical seals whenever possible. The reason has nothing to do with relative merits of packing vs. mechanical seals for any particular application. Packing requires liquid leakage through the seal. Unless this seepage is collected or channeled properly, it runs down over the pump housing, the mounting and the floor. From an appearance standpoint, this arrangement is poor. Specification of the proper type seal is influenced by two major factors, temperature and suction conditions.

Critical temperature range is between 200 and 212 deg F. This is the critical area where water will flash into steam on release to atmosphere. Both mechanical seals and stuffing boxes need lubrication. Although mechanical seals are designed to run dry for limited periods of time, extended periods of running dry will almost certainly reduce the seal life considerably. In the case of packing, an unlubricated stuffing box may result in scoring the shaft or shaft sleeve. Additional heat build up can even cause fire in the stuffing box.

Temperature limitations on packing depends on the type of packing used. Generally, above 250 deg metallic packing should be specified. When you get into such specialized conditions, it is best to refer the operating conditions to the pump manufacturer and ask for his recommendations. Another condition

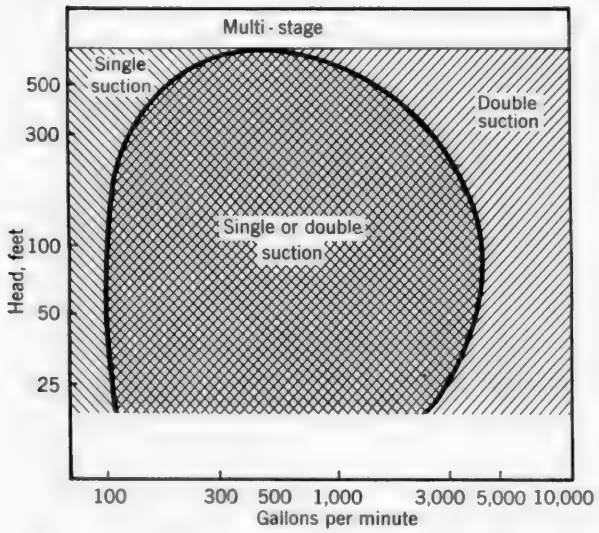


Fig. 3. In general, single suction and double suction pumps are selected in the gpm vs. head areas shown above, with the area between being one where either type might be used.

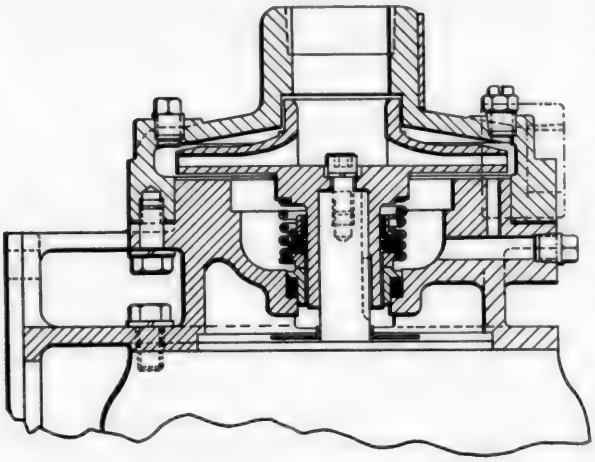


Fig. 4. When suction pressures are below 5 psi an arrangement such as shown here is used. The discharge pressures are employed in the stuffing box.

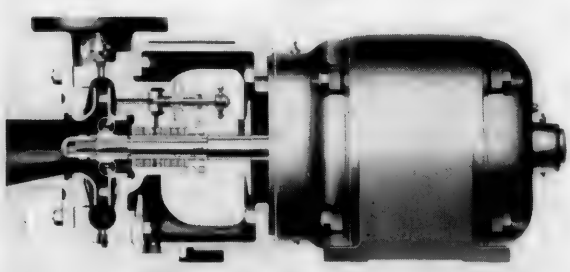


Fig. 5. Where the impeller is vented to provide hydraulic balance, as in this case, pressure in the stuffing box approximates suction pressure.

that should be referred to the manufacturer is when the liquid to be pumped is of questionable lubricating quality.

Seals are often limited by the suction conditions. Standard packed stuffing box arrangements are normally suitable from approximately flooded suction to as much as 50 to 75 psi in commercially available units. Higher suction pressures require skilled maintenance personnel to maintain the packing in good working order. Suction lifts require external injection to prevent air from leaking through the packing, thereby causing the pump to become air bound and lose its prime.

Standard mechanical seals can be used with pressures of 5 to 75 psig *in the stuffing box* without special considerations. Suction pressures below 5 psi normally entail some arrangement such as shown in Fig. 4 whereby discharge pressures are utilized in the stuffing box. This then makes the pressure in the stuffing box equal to the suction pressure plus a percentage of discharge pressure and provides for circulation through the box. This applies only to designs (generally single suction) where the stuffing box is on the opposite side of the impeller from the suction. Where the stuffing box is on the suction side (as with standard double-suction pumps) or where the impeller is vented to provide hydraulic balance (see Fig. 5), pressure in the box approximates suction pressure.

At times it may be necessary to have a stuffing box pressure in excess of 150 psi, as when two pumps are used in series. There are two methods commonly employed to prevent the pressure in the stuffing box from rising above an acceptable level. A special impeller with vanes—usually radial—on the stuffing box side of the impeller, can keep the stuffing box pressure below discharge pressure. Or, higher pressures can be handled by balanced mechanical seals. Neither of these designs are normally offered as standard equipment on commercially available units for the air conditioning industry.

Another factor to consider with high suction pressure is the effect on the pump casing and connections. Pump casings are designed to withstand the pressures generated plus standard suction pressures. With elevated suction pressures, care must be taken to maintain the final discharge pressure below the design strength of the casing and the connections. Most manufacturers have generous safety factors for casing design so that this problem does not present itself unless higher suction (75 psi and above) conditions are encountered. Connections to the pump present similar limitations. Screwed flanges are commonly offered for the great majority of applications. Where higher pressures are encountered flanged connections should be specified.

In the concluding article of his four part series next month, Mr. Pollak will show how to size the pump and where to put it.

Why this California office building has

- **Electric heating and cooling**
- **Pressure plenum air supply**

COLMAN J. MULLIN

Mechanical Engineer
James H. Van Dyke and Associates
Architects and Engineers
Los Angeles, California

THE Torrance, Calif. office building for R. C. Mahon Company (Mahon-West) presented a problem in that as much of the site as possible had to be used for manufacturing and storage of raw material. In addition, there were problems of drainage, a serious consideration in the level parts of the Southern California seacoast. Finally, there was a local code requirement for adequate employee parking.

Building design was to incorporate as much of the client's steel and other metal products as possible, yet the building was to maintain the "California look".

We feel the final solution did all that. Mechanically and electrically the problem of product usage was made much simpler by the adaptability of Mahon Cell Beam ceiling and floor panels. The panels are convertible on a modular basis from an acoustical pan, an electrical duct, light troffer, sprinkler pipe space to a combination air duct and diffuser. See Fig. 1.

Pressure Plenums

A basic concept of the air conditioning system was that of pressure-displacement, in which an entire ceiling, or large sections well distributed over the area, are used as pressure plenums. Supply air is fed through many small orifices. See Fig. 2. It is returned through one or more return openings from each zoned space. In this instance we were able to use single return ducts from more than one zone.

This system of air supply has several advantages, one of which

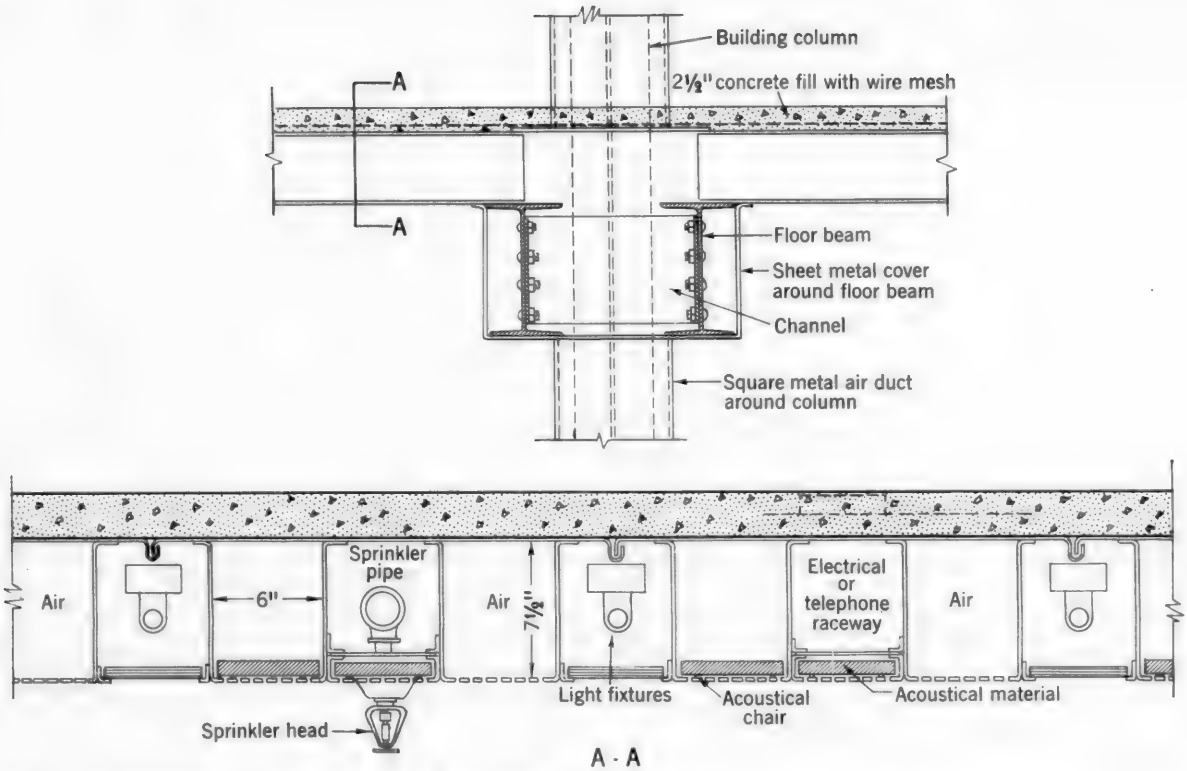


Fig. 1. Air distribution and services are all in ceiling.

is that a blanket of supply air fed evenly over a large area tends to prevent aspiration at the ceiling surface. Air mixing first occurs from 4-6 inches below the ceiling surface, providing clean ceilings for many years. Another result of this system is an extremely low temperature difference from ceiling to floor, often as low as one degree. Smoke dissipation is almost magically accomplished by the many small jets of supply air.

The 125 ft x 50 ft building is located on the north property line and orientated almost directly north and south with the 125-ft dimension on the east-west line. This causes extremely heavy exposure to the south. One of the first considerations was some type of solar shading to reduce this load. Semi-adjustable louvers were installed after an economic justification had been made. Because of the high solar load in this area, while on full cooling on the south side, this 50-ft deep building would require tempered air on its north portion.

Due to space limitations, allocation of an area for mechanical and

Fig. 2. Acoustical tile diffuser for office, lobby, conference room.

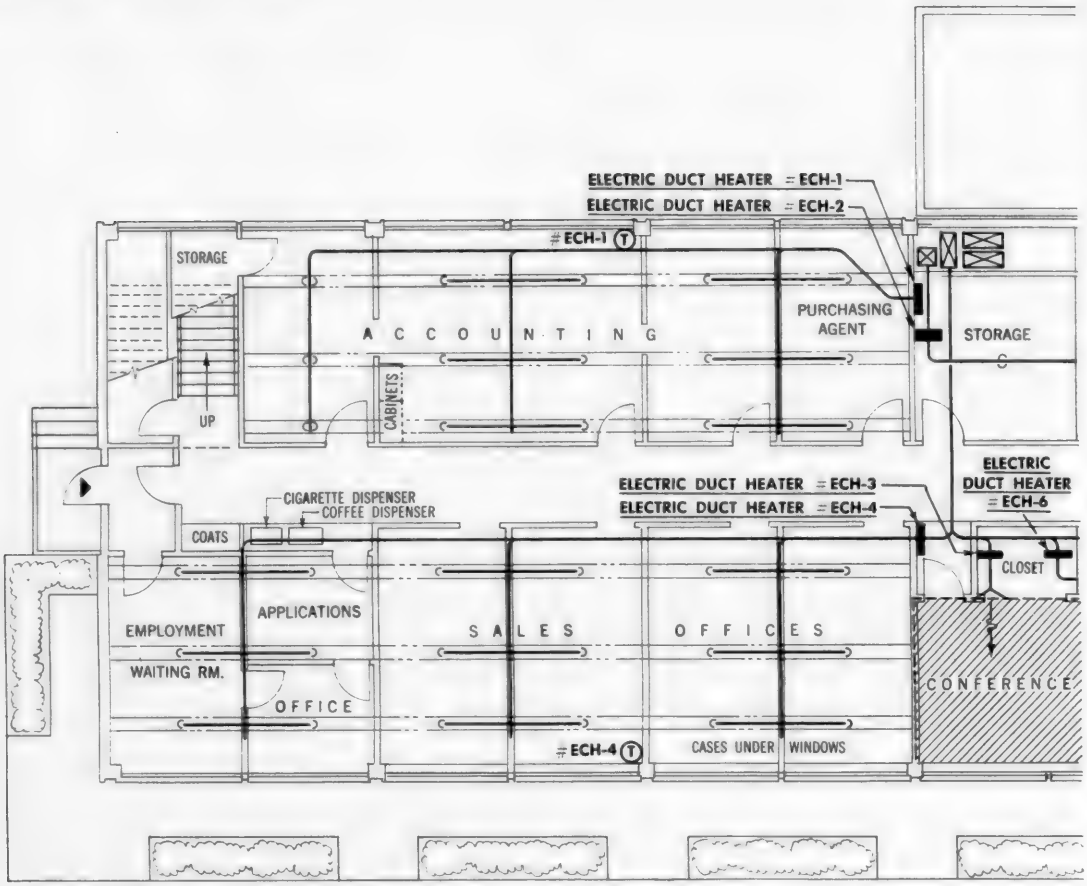


Fig. 3. First floor plan of office building, Torrance, Calif., for the R. C. Mahon Company, showing air distribution system with electric duct heaters and thermostats for zone control.

electrical equipment was a complicated problem. At this time we found that the factory electrical load was going to be very large. Further inquiries and a consultation with the Edison Company provided basic information that indicated electrical heat was not only the space answer but could likewise be justified economically.

Temperature data for a period of three years was obtained from the U. S. Weather Station located approximately 12 miles distant and *which was subject to the same general conditions as the site.* This was important because, within a 12-mile radius, it is possible to vary from a 90 deg F design temperature to 105 deg in summer, 40 to 30 deg in winter.

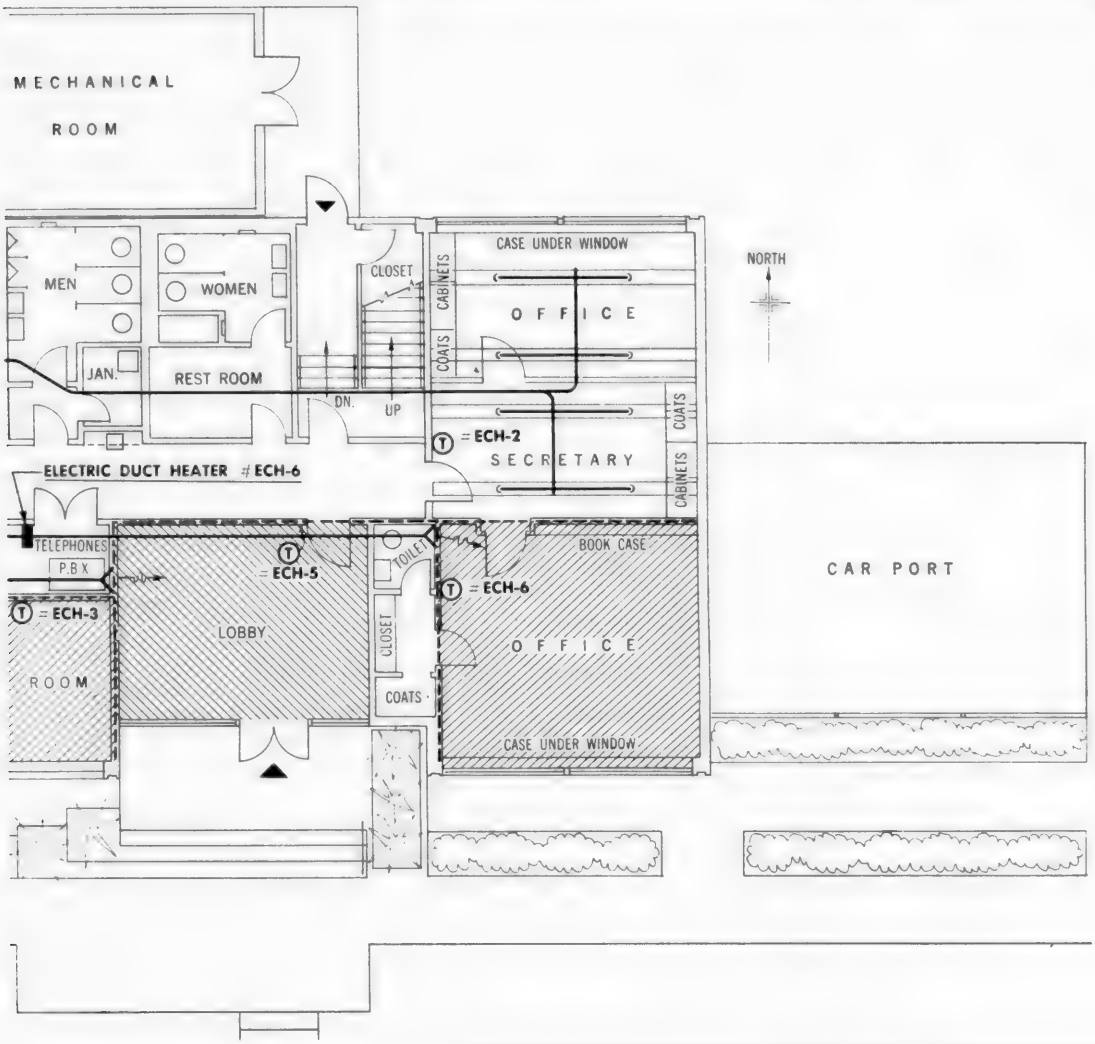
Justification for Electric Heat

Heating load was based on a 35 deg F outside temperature with an inside temperature of 70 deg. The design load for heat loss was 360 MBh (1000 Btu per hr).

Solar heat gain is a very important factor in Southern California. It affects the heat load very positively from November to March. The sun's altitude at 12:00 noon during this period varies from 51 deg (October and March) to 33 deg in mid-December. This orientation of the sun provides a very high solar gain through wall and window areas counteracting the effect of lower ambient temperatures surrounding the building.

Heat gain from lighting and population was 181 MBh. We assumed that 150 MBh would offset part of the heat loss, allowing 31 MBh as a safety factor. No credit was allowed for solar heat gain. This source of heat would not offset losses in the 7:00 to 8:00 a. m. period.

The temperature difference between 35 and 70 deg was divided into seven 5-deg increments. The heat loss of 360 MBh, divided by seven, is approximately 50 MBh per 5-deg temperature change. Assuming a credit of 150 MBh for heat gain from lights and other internal sources, there is left a difference of 15 deg (at 50 MBh/5F) from inside temperature before there will be a call for heat.



This would be an outside temperature of 55 deg or lower. Except for one reading in January of 35 deg, all the low readings were about 40 deg. This would indicate a need for supplemental heat of 150 MBh on a 40-deg day (55 − 40 = 15F). The attached tabulation, Fig. 4, is based on 50 MBh/5F difference times the number of days within the stated temperature range. The same conditions were assumed for both electric and gas heat.

The unit price for electricity is based on the factory plant demand load as the heating elements were to be 480 v, 3 ph, 60 cy. The electrical supply comes through a single meter and the owner provided stepdown transformers. Gas

CONTROL SEQUENCE

I *Time Clock energizes all circuits:* (a) Multi-zone unit, (b) temperature control circuit, (c) compressor, (d) evaporative condenser, (e) electrical heating elements, and (f) exhausters E-1 and E-3.

II *Outside Air Bulb:* Over 70F shuts OSA damper to minimum. Under 70F to 55F opens OSA to maximum and closes RA damper if all zone stats are on cooling. Any zone stat calling for heating overrides OSA bulb and sets OSA at minimum and RA at maximum. Under 55F OSA bulb sets RA damper at maximum and OSA at minimum.

III *Zone thermostat* modulates zone dampers from cooling to bypass aid depending on call. First demand for heat puts zone on full bypass. Second call for heat actuates program motor bringing electric duct coil on in stages. Any thermostat calling for cooling activates cold plenum stat which as designed should be set at 50F. OSA bulb at 65F outside temperature activates cold plenum stat.

IV *Room thermostats* control smaller areas on call for heating. With zone stat calling for cooling, local electric coil will provide heat, tempering individual area supply.

V When air handling unit is on maximum OSA an interlock releases relief dampers on roof outlet of RA duct spilling excess air.

unit price is based on a GH2 uninterruptible schedule for firm industrial heating.

Making an allowance for a spread of temperatures of 3 hours from one range to the next where they are below 60 deg, we arrived at a figure of 17,200 kw for the heating season. At $.01/kwh, this is $172. To compare this with gas, 17,200 kw = 8,500,000 Btu = 8,500 cu ft at 1,000 Btu per cu ft natural gas. Assuming 80% efficiency for a gas-fired duct heater, heating cost at the GH2 rate would be $587.

We reasoned, also, that gas heat from a duct-type heater for the air quantities required would require considerably more sheet metal work, floor space and dampers, with accompanying control equipment and that zone control would be on a much less critical basis with the probability of hot and cold areas dependent on wall orientation. With gas heat there is also the maintenance of the equipment, controls and pilot burners.

Equivalent of Double-Duct

Electric heating elements of the required wattage can be strategically located to provide sub-zone temperature modulation, thereby reducing the supply-air duct work. No maintenance is required on the duct heating coils and unless there is a demand for heat there is no current consumption.

The great advantage of the electrical elements is that we get the equivalent of a double duct system at a much lower installation cost. Because of the high radiant or solar gain in this area, it is possible for one side of the building to require refrigeration while the other still requires heated air. By putting individual duct coils under control of room thermostats, areas needing heat or heat-tempered air can be satisfied while still providing cooling in remainder of the zone.

The multizone unit is provided with DX coils but no heating coil, thereby allowing a bypass section for recirculation of air in the temperate range 60-70 deg outside.

On the basis of the foregoing analysis, we recommended the use of electric heat. The areas were set up into separate zones and the duct heaters allocated to smaller areas within these larger zones. See Fig. 8. Heating thermostats were located in these sub-zones. With these thermostats and programing motors controlling the multi circuited duct coils, a relatively fine control of air conditions can be realized.

After approximately two years of operation, the owners state that their air conditioning system is excellent and there are never any complaints of drafts or temperature variation.

Outside Temp, Deg.F	No. of Days Av. Temperature Falls Within Temp. Range in Col. 1												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
7 A.M.													
40-50	18	6	0	0	0	0	0	0	0	0	5	8	37
51-60	13	18	30	29	6	0	0	0	3	10	23	22	155
61+	0	4	1	1	25	30	31	31	27	21	2	1	173
12 Noon													
40-50	4	0	0	0	0	0	0	0	0	0	0	0	4
51-60	13	8	2	3	0	0	0	0	0	0	0	1	27
61+	14	20	29	28	31	30	31	31	30	31	30	30	334
5 P.M.													
40-50	4	0	0	0	0	0	0	0	0	0	0	0	4
51-60	23	13	13	11	0	0	0	0	0	1	5	1	81
61+	4	8	18	19	31	30	31	31	30	30	25	30	280

1 day 35 deg. F in January

7 A.M.

37 days @ 40-50 deg x 150 MBh = $\frac{5550 \text{ Mbh}}{3.4}$ = 1632 kw x $.01 = $16.32

155 days @ 50-60 deg x 50 MBh = $\frac{7750}{3.4}$ = 2280 x .01 = 22.80

173 days above 60 deg - no heat required

12 Noon

4 days @ 40-50 deg x 150 MBh = $\frac{600}{3.4}$ = 111 x .01 = 1.11

27 days @ 50-60 deg x 50 = $\frac{1350}{3.4}$ = 400 x .01 = 4.00

334 days above 60 deg - no heat required

5 P.M.

4 days @ 40-50 deg x 150 MBh = $\frac{600}{3.4}$ = 111 x .01 = 1.11

81 days @ 50-60 deg x 50 = $\frac{4050}{3.4}$ = 1200 x .01 = 12.00

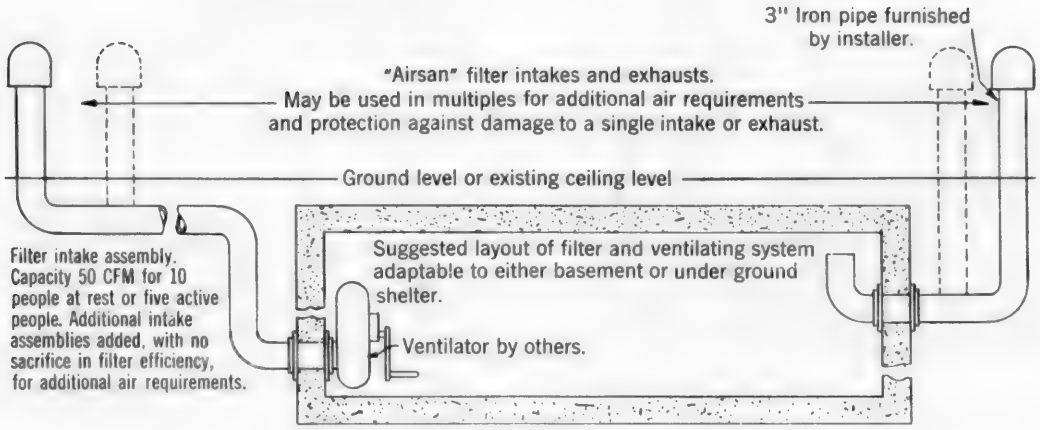
280 days above 60 deg - no heat required

Fig. 4. Work sheet for electric heating costs.

Fallout Shelter Equipment and Systems

THE INCREASING AMOUNT of personal and official attention being given to fallout shelters, both family and community types, is being reflected in the news of equipment and literature reaching the editors' desks. In the future such information will be carried in our regular "New Equipment" and "New Literature" departments, but this month, because of the novelty, we are presenting a special section on products, systems and literature related to that contemporary structure: The Fallout Shelter.

Air Filter System for Fallout Shelters


3" Iron pipe furnished by installer.
"Airsan" filter intakes and exhausts.
May be used in multiples for additional air requirements and protection against damage to a single intake or exhaust.
Ground level or existing ceiling level
Filter intake assembly. Capacity 50 CFM for 10 people at rest or five active people. Additional intake assemblies added, with no sacrifice in filter efficiency, for additional air requirements.
Suggested layout of filter and ventilating system adaptable to either basement or under ground shelter.
Ventilator by others.

Of timely interest to firms engaged in the construction of basement, underground or outside fallout shelters is a rugged air intake, filtering and exhaust system that exceeds rigid Civil Defense Administration requirements. The inexpensive system, designed and manufactured by Air Filter Corp., Milwaukee, Wis., is available through Will-Win Associates, Milwaukee, national sales directors. Air Filter Corp. is the manufacturer of Airsan filters for products in the industrial, commercial and institutional fields.

Priced just under sixty dollars, the new system is simple to install and consists of two heavy steel hoods, one that fits securely over the shelter's air intake pipe, the other over the exhaust pipe; an easily replaceable 30-inch long filter that slips into the intake pipe entrance; and an anti-backdraft valve in the exhaust hood that opens only when a positive air flow is forced through the shelter.

Heart of the system is the specially designed filter, which will permit an air flow of up to 300 cubic feet per minute—a more than adequate supply for several people in the shelter. The average hand-powered or battery-driven air blower on the market today is designed to deliver about 50 cubic feet of air a minute, sufficient for ten people at rest, or five engaged in activity.

Filter media is supported by strong wire mesh and will block the passage of particles down to ten microns in diameter. Filter media will not sag, shift or rupture. A gasket surrounding the top of the filter assures positive sealing against the intake pipe to prevent air from bypassing the filter. The filter is designed to provide protection from fallout materials during the critical period following a nuclear explosion when it would be unsafe to leave the shelter.

Made of 18-inch deep-drawn steel, the intake and exhaust hoods are designed to withstand shock pressures of up to 100 pounds per square inch. They attach securely to 3-inch IPS iron pipes, the standard size recommended by the Civil Defense Administration. Fitting like caps over the pipe ends, the hoods also provide a baffle that reduces the entrance of radioactive particles. The anti-backdraft valve prevents contaminated air from entering the shelter through the exhaust pipe.

More Information? Circle Item 1 on Inquiry Card.

Fallout Shelter Ventilator

A fallout shelter ventilator, called the Shelt-A-Vent, is available from the Lau Blower Co., Dayton, Ohio. It can be operated either by hand or through a motor connected to any regular 110 volt circuit.

The motor provides ventilation to remove stale damp air prior to a shelter's occupancy or while electricity is still available. With the hand crank, the ventilator delivers the same amount of air, through turning a gear drive, as with the motor.

Since the ventilator would not have to be continuously operated while the shelter is occupied, only

periodic hand cranking would be necessary to bring in fresh air. When electricity is available, it can be connected to an automatic timer for periodic air moving.

Mounted on a galvanized steel base with a clamp, the ventilator can be mounted on a table, sill, ledge, or beam. Standard six-inch diameter ductwork is connected to the ventilator's side and runs to the outside of the shelter for fresh air intake. A reducing collar can be attached for smaller diameter ducts. It delivers 100 to 250 cfm of air, depending on diameter of the intake duct.

More Information? Circle Item 2 on Inquiry Card.

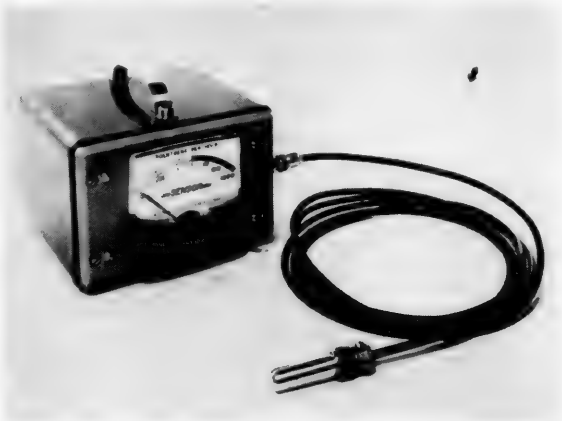
Radiation Measuring Device

Radiation Equipment & Accessories Corp., Lynbrook, N. Y., announces the first commercially available radiation instruments designed specifically for fall-out shelters.

Called the Sensor, the device provides radiation level information of the immediate shelter vicinity without the necessity of going outside and being exposed to possible high levels of radiation.

Employing the basic, proven features of radiation measuring devices used for years, the detector is mounted outside on a post, or on the side of a building. It is contained in a waterproof housing and it is rugged enough to withstand all ordinary hazards.

The indicator is pushbutton operated to conserve battery life. The instrument dial is direct reading, with dangerous radiation levels shown in red. A cable (50 feet supplied) leads from the detector into



the shelter and connects to the indicating unit. An optional probe on a 3-ft cable is available to convert the unit to a portable instrument.

Once installed it requires no maintenance. There are no additional costs, beyond perhaps, replacement of its inexpensive standard flashlight batteries.

Although the device is designed and priced for installation in the most economical home shelter it will serve equally as well in large community shelters, offices, factory buildings, schools and churches designated as shelter areas.

More Information? Circle Item 3 on Inquiry Card.

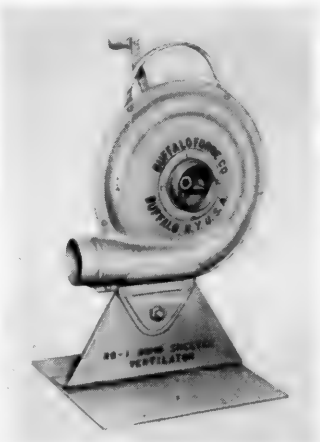
Exhaust Ventilators and Access Hatches

A folder offered by Penn Ventilator Co., Inc., Philadelphia, Pa., concerns itself with the availability and application of devices recommended and suitable for use on fallout shelters. These are standard, commercial exhaust ventilators and metal access doors or hatches. Products are illustrated and described, and their function in fallout shelters is covered in detail.

The folder also lists other technical publications offered by various sources, such as U.S. Government Printing Office and Office of Civil and Defense Mobilization, Penn calls these publications authoritative and comprehensive, and recommends them to those engaged in the design and construction of family and group fallout shelters.

Circle Item 4 on Inquiry Card.

Ventilator Line for Fallout Shelters



Buffalo Forge Co., Buffalo, N. Y., has developed a line of compact CD-recommended ventilators for emergency use in family-type and medium sized fallout shelters.

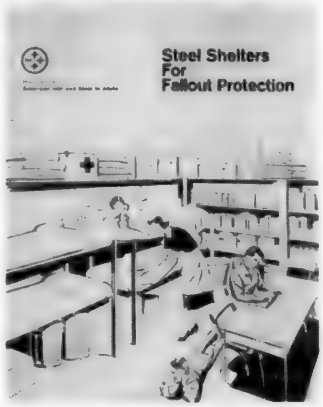
Models for family-type shelters (up to 10 persons) include a hand-operated ventilator plus an electric motor driven unit with provisions for hand operation in the event of power failures. Units are designed to deliver up to 50 cubic feet of fresh air per minute.

Models for medium group-type shelters (up to 75 persons) also include hand-operated and manual/electric models. Fresh air capacity of both is rated at 375 cfm.

Largest model in the line occupies less than 2¼ sq ft of floor space. Special gearing on all models assures easy, almost effortless hand-operation. For protection against radio active fallout, filters built to rigid U. S. Atomic Energy and Army Chemical Corps standards are available for each model.

More Information? Circle Item 5 on Inquiry Card.

Steel Fallout Shelters



A steel fallout shelter structure covered with sand, soil or open hearth slag has eight basic advantages, according to a booklet just prepared by American Iron and Steel Institute.

The booklet, which outlines the requirements of an adequate fallout shelter, contains clear drawings of various types of effective steel shelters. It is being made available to the public through the Office of Civil Defense of the Department of Defense, which cooperated in the preparation of the publication.

Requirements covered include shielding, shelter material, size, location and entrance; also, ventilation, radio reception, lighting and drainage.

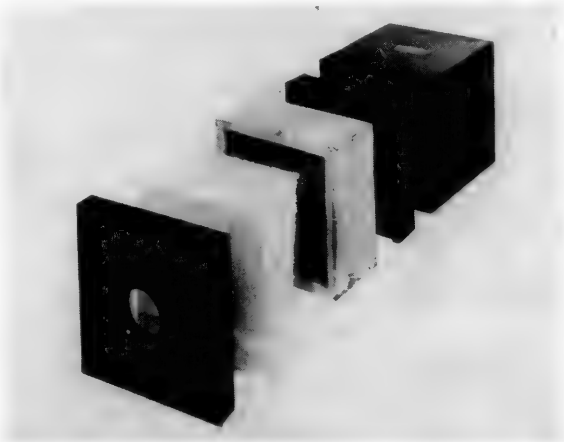
The booklet suggests that a steel fallout shelter, if properly planned and located, can be adaptable for use during periods other than a national emergency. It can serve as a spare room, a den or an office, a workshop utility room, photographic dark room, a recreation or game room, a reading or TV room, a storm protection room, or a room in which to store vegetables and food.

The booklet also contains a list of supplies and equipment for fallout shelters and lists the American Medical Association's recommendations of medical publications useful for the shelter.

Circle Item 6 on Inquiry Card.

Fallout Filter Unit

Barnebey-Cheney Co., Columbus, Ohio, announces a 3-stage fallout filter unit suitable for offering protection from atmospheric contamination in the event of nuclear attack.



The fallout filter unit is designed to provide the greatest possible protection against large and small radioactive dust particles, chemical and biological agents, and poisonous gas. The high-efficiency filter will remove radioactive dust particles as small as 0.3 microns. It also has the capability of removing bacteria up to 99%. The activated charcoal filter will remove toxic gases, the company discloses.

Filter unit is designed to be placed either inside or outside the underground shelter. Encased in a sturdy steel frame 12¼ inches square by 14 inches long, the fallout filter unit is reported to be a proven, safe method of protection for shelter occupants against contamination.

More Information? Circle Item 7 on Inquiry Card.

Additional product information and the two pieces of literature described can be obtained by circling the appropriate inquiry number on a readers' service card in back of magazine.

NEW LITERATURE

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Multizone Air Conditioning Units

A 64-page bulletin, 34, describing the line of multizone air conditioning units offered by Marlo Coil Co., St. Louis, Mo., is now available. Contains photos, drawings, charts and diagrams. Information is provided on features, components, and coil selection.

Circle **Item 8** on Inquiry Card

Wall Closet Supports

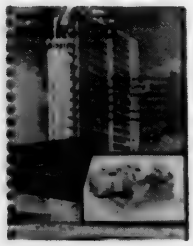
Manual 60-4, announced by Zurn Industries, Inc., Hydromechanics Div., Erie, Pa., illustrates how the Monolithic wall closet support system supports long-run batteries of siphon-jet wall closets. Features section on selection of Zurn system for particular applications.

Circle **Item 9** on Inquiry Card

Close-Coupled End-Suction Pumps

Eight-page Bulletin 108 illustrates and describes Type GBH close-coupled end-suction centrifugal pumps, manufactured by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill. Contains selection charts, dimensions, specifications, limitations chart and more.

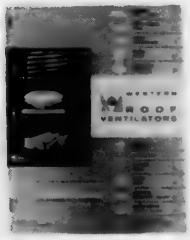
Circle **Item 10** on Inquiry Card



Water Booster System

The Ever-Flo water booster system is discussed in 4-page Bulletin EF-250A, published by Weil Pump Co., Chicago, Ill. The bulletin includes a general description of the system, construction data, features, dimensions, typical selection tables and applications.

Circle **Item 11** on Inquiry Card



Roof Ventilators

Compact roof ventilators are the subject of 12-page Bulletin CPG-62, announced by Western Engineering & Mfg. Co., Los Angeles, Calif. Centrifugal, axial, gravity and rotary ventilators are covered. Includes engineering data, features, capacity charts and more.

Circle **Item 12** on Inquiry Card

Odor Control

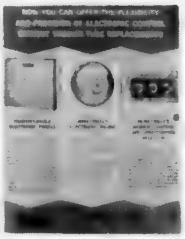
A new 20-page booklet, describing an inexpensive way to control odors, is available from Solvay Process Division of Allied Chemical Corp., New York, N. Y. Booklet tells how Ozene, a bacteria, fungus and odor suppressant, controls objectional odors and their causes.

Circle **Item 13** on Inquiry Card

Air Measuring Instruments

Bulletin 2448, featuring the Velometer and other air measuring instruments, is available from Alnor Instrument Co., Division of Illinois Testing Laboratories, Inc., Chicago, Ill. Contains information on air flow measurement valuable to the engineer and contractor.

Circle **Item 14** on Inquiry Card



Electronic Control Systems

A pamphlet published by Minneapolis-Honeywell, Minneapolis, Minn., discusses features of 3 of its newest control systems. Systems discussed are Electronic Round thermostats, transistorized electronic panels, and remote control air conditioning selector.

Circle **Item 15** on Inquiry Card

Boiler Feedwater Treatment

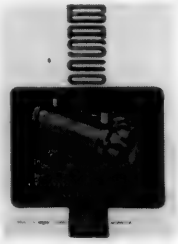
Bulletin 30, a 24-page booklet titled "An Introduction to Boiler Feedwater Treatment," is available from Nalco Chemical Co., Chicago, Ill. It covers such topics as: Why water treatment is needed; removing impurities from water; and treating boiler feedwater.

Circle **Item 16** on Inquiry Card

Forged Steel Valves

This 8-page catalog, FV-1, describes the line of forged steel valves offered by Stockham Valves & Fittings, Birmingham, Ala. Sectioned drawings and charts supply all necessary information, including dimensions, sizes, working pressures and materials.

Circle **Item 17** on Inquiry Card



Compact Heat Exchanger

Complete information on a line of stock model compact heat exchangers is presented in a 4-page illustrated bulletin, F-1161, published by Basco, Inc., North Tonawanda, N. Y. Construction features are described and standard sizes, dimensions, and weights are listed.

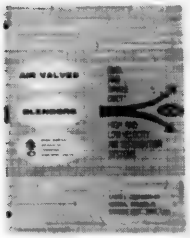
Circle **Item 18** on Inquiry Card

Sewage Treatment Plant

The Oxigest sewage treatment plant, designed for use in outlying areas without municipal sewerage facilities, is described in a brochure offered by Smith & Loveless, Division Union Tank Car Co., Kansas City, Mo. Explains aerobic digestion process used by plant.

Circle **Item 19** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Air Distribution Systems

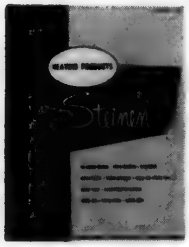
Catalog 1161 covering a line of air valves, blenders, and high capacity acoustic terminal control units is announced by Carnes Corp., Verona, Wis. Catalog contains description of units, capacity tables, and a complete attenuation analysis plus suggested specifications.

Circle **Item 20** on Inquiry Card

Classroom Unit Ventilators

Equipment designed to provide automatic temperature control of all damper-controlled air conditioning classroom units ventilators is described in Bulletin F-10151-1, available from Barber-Colman Co., Rockford, Ill. Explains how control simplification was accomplished.

Circle **Item 21** on Inquiry Card



Heating Products

A line of heating products is discussed in 20-page Catalog H-61 by Wm. Steinen Mfg. Co., Heating Div., Newark, N. J. Catalog consists of 3 main sections: Oil burner nozzles; oil burner accessories; and draft control. Supplemental text gives complete technical information.

Circle **Item 22** on Inquiry Card

Industrial Lubricants

A 16-page brochure, outlining a complete line of industrial lubricants and a method to streamline industrial lubrication programs and cut costs, is available from The Pure Oil Co., Palatine, Ill. Characteristics and function of more than 60 lubricants are given.

Circle **Item 23** on Inquiry Card

Ball Valves

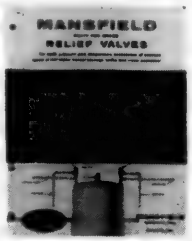
This 4-page brochure describes the line of ball valves available from Worcester Valve Co., Inc., Worcester, Mass. It enables users to select the correct size and combination of metals, seals, seats and pipe ends. Photos, drawings and charts give complete information.

Circle **Item 24** on Inquiry Card

Airfoil Fans

Information on performance and characteristics of the SQ airfoil line of fans for industrial air handling applications, is available in Bulletin ASQ-102 from Chicago Blower Corp., Franklin Park, Ill. Covers design features, diagrams, and selection tables.

Circle **Item 25** on Inquiry Card



Relief Valves

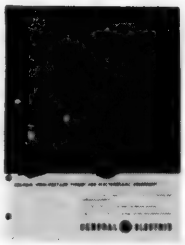
A 6-page bulletin, describing 11 relief valves, is announced by Mansfield Sanitary, Inc., Perrysville, Ohio. Discusses and illustrates features of each model. A chart summarizes each valves use, size, maximum and standard pressures, temperature setting and more.

Circle **Item 26** on Inquiry Card

Centrifugal Pumps

Information on bearing life, shaft deflection, interchangeability charts and diagrams, as well as complete performance, application and dimension data is included in Bulletin 725.1 describing the line of chemical process pumps offered by Gould Pumps, Inc., Seneca Falls, N. Y.

Circle **Item 27** on Inquiry Card



Electrostatic Equipment

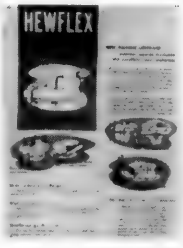
Eight-page Bulletin GEA-7328, published by General Electric Co., Schenectady, N. Y., lists features and advantages of its power packs for reliable, high-voltage power for electrostatic equipment. Includes applications, diagrams, dimensions, specification charts and more.

Circle **Item 28** on Inquiry Card

Sound Control Products

A 30-page illustrated catalog, 62, issued by Elof Hansson, Inc., Acoustical Div., New York, N. Y., covers over 440 types and qualities of acoustical products. Items are in categories according to function and purpose with technical information and illustrations.

Circle **Item 29** on Inquiry Card



Urethane Pipe Insulation

A 2-page brochure, describing Hewflex urethane pipe insulation, is announced by United Foam Products Co., Bethel Park, Pa. Covers the outstanding characteristics such as its low k value, resistance to water, extreme flexibility and high impact resistance.

Circle **Item 30** on Inquiry Card

Water Treatment Chemicals

Literature on a line of chemicals for use in both heating and cooling systems is announced by Acme Chemical Co., Milwaukee, Wis. Includes drawings, photos, and descriptions which illustrate how the chemicals eliminate new and existing scale and corrosion.

Circle **Item 31** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Close-Coupled Pumps

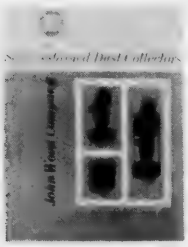
Type VC and VCS close-coupled pumps are the subject of 4-page Bulletin 10-C, available from Skidmore Corp., St. Joseph, Mich. Contains general information on this type of pump, construction features, and engineering, capacity and dimension tables.

Circle **Item 32** on Inquiry Card

Steam Heating Specialties

A complete line of steam heating specialties is presented in a new catalog, Form 1501D, by Dunham-Bush, Inc., West Hartford, Conn. Includes illustrations and product drawings, information on capacities, dimensions and weights of traps, floats, strainers and gages.

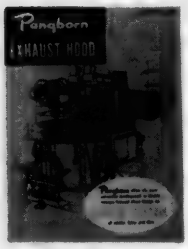
Circle **Item 33** on Inquiry Card



Self-Contained Dust Collectors

Self-contained air pollution control equipment for control of industrial dust is outlined in Bulletin 230 by John Wood Co., Air Pollution Control Div., Florham Park, N. J. Covers self-contained cyclone separators, fabric filters, and combination fabric/cyclone separators.

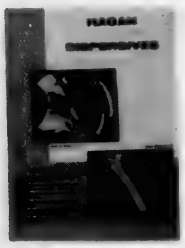
Circle **Item 34** on Inquiry Card



Electric Furnace Fume Control

How to control electric furnace fumes is explained in 6-page Bulletin 924 by Pangborn Corp., Hagerstown, Md. Photos and sketches show how a new exhaust hood, combined with a synthetic-fabric dust collector, eliminate electric furnace smoke and fumes.

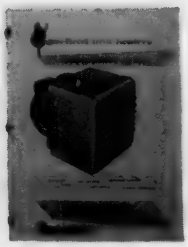
Circle **Item 35** on Inquiry Card



Dispersives

Custom engineered dispersives to minimize sludge formation in boilers and recirculating cooling systems are discussed in Bulletin HSP-941 available from Hagan Chemicals & Controls, Inc., Pittsburgh, Pa. Selection of proper dispersive is discussed.

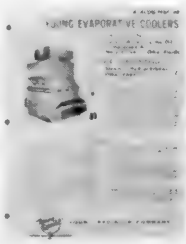
Circle **Item 36** on Inquiry Card



Gas-Fired Unit Heaters

This 4-page bulletin, A-917, available from American-Standard Industrial Div., Detroit, Mich., describes the Series NB centrifugal blower type gas-fired unit heater. Includes construction features, photographs, performance and layout data, and dimensions.

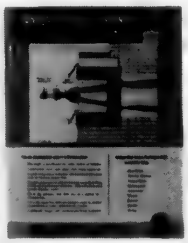
Circle **Item 37** on Inquiry Card



Evaporative Coolers

Evaporative coolers are the subject of 4-page Catalog 1961-4P, published by Young Radiator Co., Racine, Wis. Detailed information is given on coolers for lube oil, cooling jacket water, compressed air and natural gas, or for condensing steam and hydrocarbons.

Circle **Item 38** on Inquiry Card



Combustion Units

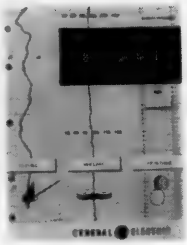
Two-page Bulletin 50, offered by National Airfoil Burner Co., Philadelphia, Pa., describes the Tandem combustion unit and provides outline drawings and capacity data on the units. Bulletin also includes a list of typical situations to which the unit may be applied.

Circle **Item 39** on Inquiry Card

Ball Valves

Detailed information on the line of manually and pneumatically operated ball valves manufactured by Hills-McCanna Co., Carpentersville, Ill., is presented in Catalog 1200-A. Discusses suitability of body and seat materials for a wide range of chemical services.

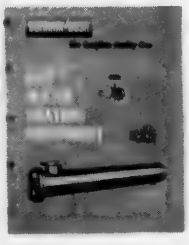
Circle **Item 40** on Inquiry Card



Recorders

The full line of direct and servo-operated, switchboard and portable recorders is described in Brochure GEA-6933A, offered by General Electric Co., Schenectady, N. Y. Relates information on types of recorders and the electrical and physical parameters measured by them.

Circle **Item 41** on Inquiry Card



Hot Water Heating Equipment

A hot water heating equipment catalog, Form 1551B, offered by Dunham-Bush, Inc., West Hartford, Conn., introduces the ASME expansion tank, steam and water converters with typical installation diagrams. Covers circulators, valves, fittings, specialties and converters.

Circle **Item 42** on Inquiry Card

Pumps

Complete engineering data on pumps is described in a new 1008-page Pic-A-Pump catalog available by letterhead request from Allis-Chalmers, Advertising Dept., Box 512, Milwaukee 1, Wis. Includes parts listing, prices, and a 64-page reference section covering pump data, design, tables and charts.

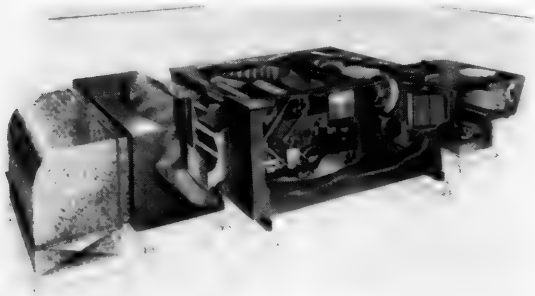
NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

Roof Units Heat, Cool, Ventilate

A new line of roof-top units is offered with a choice of gas-fired, oil-fired or combination fuel models by Lennox Industries, Inc., Marshalltown, Iowa. They are designed for heating only, with or without filters; heating and ventilating, with or without filters, and with manual or automatic dampers to proportion fresh and return air; and heating-cooling-ventilating with manual or automatic dampers.

The heating output range of the RT units is 280,000 to 1,000,000 Btu per hr with air volume of 3,000 to 15,000 cfm. Additive direct expansion evaporator units give 10 to 45 tons of cooling.



As insurance against the possibility of induced draft fan failure, combustion air and induced draft blowers are mounted on a common shaft whose bearings are cooled by a continuous flow of outdoor air. Blower wheels are fabricated from stainless and aluminized steel and are welded to the shaft.

Single and dual fuel burners are available for No. 2 oil and natural gas and feature manual or automatic fuel changeover. Burner control includes on-off, high-low-off or full modulation.

The blower section, constructed and rated in accordance with the National Association of Fan Manufacturers, has forward curved blower wheels, statically and dynamically balanced as a complete unit.

In the heating-only version, operation of the unit is dictated by a room-mounted room thermostat. In the heating and automatic ventilating control version, provision is made for a room-mounted heating thermostat, modulating air damper motor, room-mounted minimum damper positioner and a mixed-air temperature controller.

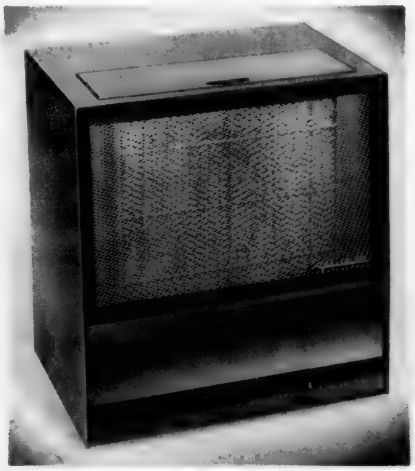
The external cabinet, which is only 65 inches high in the largest unit, is of 20 gauge bonderized-galvanized steel with a finish coating of thermosetting acrylic enamel, completely resistant to normal corrosive elements.

More Information? Circle Item 43 on Inquiry Card.

Humidifier Doubles as Air Cleaner

A design refinement in its portable humidifier, Model 136, which allows it to perform as a high capacity air cleaner during the summer months is announced by Research Products Corp., Madison, Wis.

The combination unit operates during the winter heating season as a high capacity (12 gallons of water per day) humidifier, and is equipped with a washable pre-filter for air cleaning. Humidification is by evaporation from a 2-inch water panel.



During the summer, the water panel is easily replaced by a 2-inch filter; the water pump is switched off and the unit operates as a high efficiency air cleaner only. The air is cleaned by two filters, both coated with efficient filter coat adhesive so that an unusually high percentage of dust, dirt, and pollen is trapped. Odors are reduced also, and are prevented from being re-circulated.

A 10-inch fan handles the air movement. Capacity of the unit is 200 cfm. Air in a 12 x 12 room is completely re-circulated and double filtered every 5 minutes.

More Information? Circle Item 44 on Inquiry Card.

Copper To Copper Globe Valves

Milwaukee Valve Co., Inc., Milwaukee, Wis., announces an addition to its copper to copper line of gates and checks with the addition of copper to copper globe valves, in sizes ⅜ to 2 inches, made in full compliance to federal specifications.

These valves are recommended for general services with steam, water, oil or gas. They can be repacked when wide open under pressure.

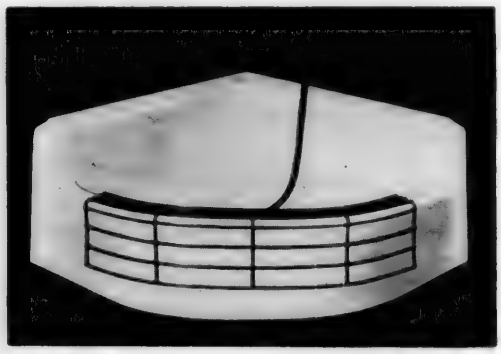
More Information? Circle Item 45 on Inquiry Card.

Sink for Apartment, Commercial Use

The problem of hard-to-clean areas, encountered under and around free-standing service sinks, has been eliminated by a curb-type floor sink developed and manufactured by American-Standard Plumbing & Heating Div., New York, N. Y. Called the Florwell, the fixture is said to be the first such service sink to be offered in enameled cast iron and is designed to be built into the corner of janitors' closets, basement rooms, and other cleaning storage areas.

The sink provides adequate drip area for mops and brushes, a major consideration in its development. Another feature is that the lifting of heavy mop buckets is made much easier by the convenient floor design.

The Florwell, available in acid-resistant enamel white, measures 28 x 28 inches. The front rim is curved, and the two back edges are provided with a 7/16-inch tiling bead for installation. The curb height is 8 inches, and the height of the back measures 13 inches from finished floor to tile head.



The bottom is designed to facilitate the placing of a container in the sink, and slopes to the drain so that water will not be left standing at any point. Drain channels are provided in the bottom to prevent the trapping of any overflow from the container. The sink can be provided with a drain for either a 2-inch caulk connection or 2- and 3-inch threaded connections.

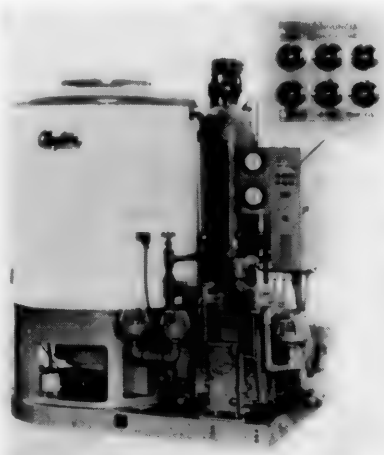
A wire rim-guard, covered with vinyl, is available for use with the sink. It adequately protects the fixture and can be easily removed for cleaning.

More Information? Circle Item 46 on Inquiry Card.

Controls Determine Boiler Failure

A steam generator that automatically indicates any cause of safety shutdown due to ignition failure, or shortages of water, fuel, electricity or combustion air, is announced by Clayton Mfg. Co., El Monte, Calif. The unit delivers 5000 to 6000 lbs of steam per hr at both high and low pressures. In multiple installations it meets requirements ranging up to 72,000 lbs of steam per hr or higher, depending on application.

This Model R-175 offers, as standard equipment, a safety lockout annunciator system that operates by means of a group of indicator lamps located on the control panel of the steam generator. In normal operation, none of the indicator lamps are activated.



In case of water shortage, over-firing, or the presence of any factor leading to excessive temperatures, the thermostat lamp lights to point out the cause of burner shutdown. Other lamps indicate such malfunctions as fuel failures, a too-high or too-low oil level in the pump crankcase, damper failures, insufficient forced draft air pressure on gas-fired models, and electrical overloads, shorts or low voltage.

More Information? Circle Item 47 on Inquiry Card.

Abrasive Drills Cut Drilling Cost

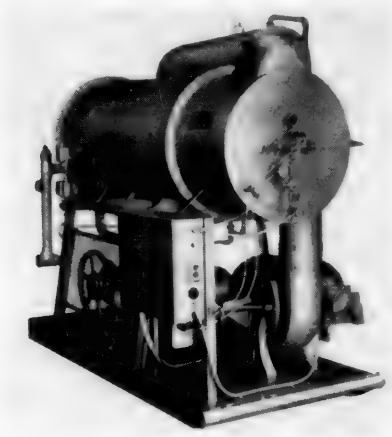
The Howe-Simpson Co., Columbus, Ohio, introduces a new line of abrasive core drills for grinding holes in reinforced concrete and other hard materials from ½ to 6-inch OD.

The chief advantage of this drilling method is that holes can be cored for ⅓ to ½ the cost of other known methods, the manufacturer claims. Other advantages of this process are no bracing or running water required, inexpensive bits, low maintenance, and semi-automatic, portable machines.

More Information? Circle Item 48 on Inquiry Card.

Hot Oil Heater Line Expanded

Vapor Corp., Chicago, Ill., has added three models of its Hi-R-Temp hot oil heater to its product line. A 7,000,000 Btu per hr input unit, a 13,000,000 Btu unit, and a 300,000 Btu unit are now available.



By means of heat transfer oils, temperatures to 600 deg F are achieved without the accompanying high pressures associated with steam plants. Economies in piping and increased safety are effected.

The units modulate automatically, require no water treatment, eliminate problems due to freezing or corrosion, and are completely unitized.

More Information? Circle Item 49 on Inquiry Card.

Fractional HP A-C Gear Motors

A line of fractional hp a-c gear motors, available in 2 distinct design types (hysteresis synchronous and low slip induction), is announced by Ashland Electric Products, Inc., Long Island City, N. Y.

The hysteresis synchronous gear motor overcomes speed fluctuations due to sudden variations in line voltage or load, a problem present in most induction motors. Shaft oscillation has been virtually eliminated providing continuous and smooth operation of the application equipment within the limits of the back lash selected. The low slip induction gear motor was designed to fulfill the needs of applications requiring high starting torque and excellent full load efficiency.

More Information? Circle Item 50 on Inquiry Card.

Urethane Insulation for Flat Roofs

A type of roof insulation, said to be twice as efficient as any ever developed for flat built-up roofs, is claimed by Allied Chemical, Barrett Div., New York, N. Y.

The insulation is based on rigid urethane foam, a plastic material honeycombed with tiny closed cells, said to provide an insulating value better than still air. Panels consist of rigid urethane foam to which tough roofing membranes have been laminated on both sides.

The panels do not expand, contract, or change shape. They do not absorb water, are unaffected by most chemical solvents, and may be walked on immediately after they are set in place. They were designed for use where roof insulation requirements are critical, such as air conditioned buildings, institutions, and structures for which maximum insulating efficiency is required.

More Information? Circle Item 51 on Inquiry Card.

Electronic Device Detects Smoke

An electronic smoke detection device, designed to operate a relay and close dampers in air conditioning and other duct systems, has been developed by Fuel Watchman, Flushing, N.Y.

The device, called Smoke Watchman, also finds use as a smoke alarm for heating systems; as a cut-off to turn off burners if smoke persists; and as an automatic gas burner control to consume smoke, soot, and fly ash in incinerators when present in excessive amounts.

More Information? Circle Item 52 on Inquiry Card.

Air Diffuser Has Large Free Area

A baseboard diffuser, only 15-inches wide, is introduced by Air Control Products, Inc., Coopersville, Mich. Although the diffuser takes less floor space than most floor diffusers, it has an available 38 sq inches of free area. Adjustable fins are pre-set to blanket up to 13 ft of wall with a wide, fan-shaped pattern.

The diffuser face can be removed and replaced any time, making installation possible on either subfloor or finished floor, against the wall, or plastered into it. Two built-in clips hold any 2¼-inch boot, up to 14 inches wide, firmly in place; no fitting or flanging is necessary.

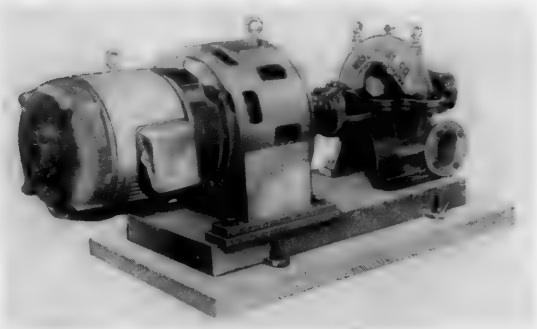
Damper opening can be limited by an adjustable stop, so the system is easily balanced at the face of the diffuser. A matching return air grille without damper is also available. Both are finished with beige baked-on enamel.

More Information? Circle Item 53 on Inquiry Card.

Constant Pressure Pumping System

Ever-Flo, a constant pressure pumping system for industrial, commercial, and residential use is available from Weil Pump Co., Chicago, Ill.

The system uses a variable speed coupling which accelerates or decelerates the pump speed to meet requirements of the system. The motor operates at



a constant speed and the pressure control is connected to the building riser. The variation in demand governs the out-put speed of the drive and the capacity developed by the pump, thus maintaining a constant pressure. It is a complete package system consisting of pump, motor, drive coupling, and control.

More Information? Circle Item 54 on Inquiry Card.

Duct Insulation Methods Improved

A new method of installing insulation in duct work which will save time, cut material costs, and insure against the problem of loose insulation clogging the ducts, is announced by Fastener Division of United Shoe Machinery Corp., Shelton, Conn.

Called the pop rivet Klip Kit installation method, the kit contains long mandrel pop rivets that are inserted and set from the same side of the work. The rivets differ from regular rivets in that the mandrel does not break after the rivet has been set. The rivets are available in two lengths for fastening insulation, such as fiberglass, up to 2 inches thick.

More Information? Circle Item 55 on Inquiry Card.

Kit Cleans Refrigeration Systems

A system cleaner kit, produced by Sporlan Valve Co., St. Louis, Mo., cleans refrigeration systems on new installations, or hermetic motor burnouts. All parts necessary to assemble the system cleaner are neatly stored in a fiberboard case that is easily transported from service truck to job.

The kit is available in two models. Kit SCK-A contains fittings, hoses, and three RCW-48 catch-all cores, the necessary parts to make up a cleaner.

Model SCK-B includes the same parts as "A" plus seven RSV-9 kits and one RSV-5 kit. The extra material permits the serviceman to make up a versatile arrangement of adaptations for switching from one size adaptor to another without additional soldering after various combinations are made.

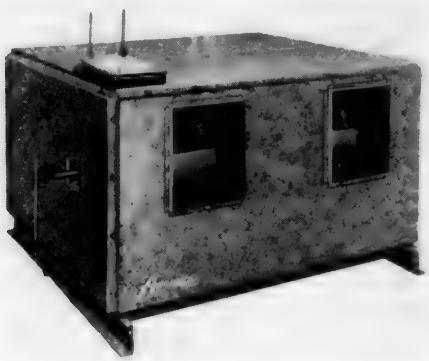
More Information? Circle Item 56 on Inquiry Card.

Improved Line of Air Handlers

An improved line of air handlers, designed and engineered for a broad range of commercial, industrial, and institutional applications, is announced by Acme Industries, Inc., Jackson, Mich., manufacturers of air conditioning and refrigeration equipment.

These units will heat or cool the air, remove dirt, humidify or dehumidify, or serve as simple air circulators when desired. They will operate with either steam or hot water as a heat source, with either a water chiller or a direct expansion coil as a cooling source.

The new line comprises a total of 37 horizontal, vertical and multi-zone type units in 14 sizes ranging in capacity from 600 to 44,000 cfm and providing a nominal outlet velocity of 1,600 fpm.



The air handlers are made of 14 and 16-gauge galvanized metal and feature 1-inch standard fiberglass insulation. No angle irons are used as all sections are made from rolled sheet metal. Two to four coil sizes in either left-hand or right-hand combinations are available for each size casing. Six motor positions and four fan discharge positions are also available.

Fans are mounted on hollow shafts designed and sized to minimize shaft deflection and increase bearing life. Only external, sealed, self-aligning Sealtite ball bearings with Alemite fittings are utilized, permitting lubrication even under adverse operating conditions to simplify service and maintenance. Panels, built on specific centers, are fastened with self-tapping, hexagon-head screws to prevent air leakage and facilitate quick, easy removal of panels when required.

More Information? Cicrle Item 57 on Inquiry Card.

695 Valve Combinations Serviced

Two service parts kits, with necessary parts for servicing 695 different valve combinations in the standard line of J-E solenoid valves and many special valve types, have been developed by Jackes-Evans Mfg. Co. Controls Div., St. Louis, Mo.

Kit No. 77555 services 615 different refrigeration

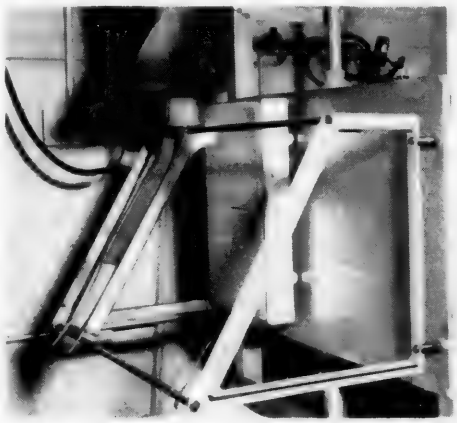
solenoid valve combinations; and kit 77554 services 80 industrial solenoid valve combinations. The kits contain all removable parts such as coils, plungers, diaphragms, seals, and bolts necessary to service a solenoid valve without removing the valve from the line. In addition to these parts, the kits also include service instruction sheets, price lists and necessary Allen wrenches.

More Information? Circle Item 58 on Inquiry Card.

Fire Hazard of Coatings Measured

Benjamin Foster Co., Philadelphia, Pa., has released information about the use of a new type apparatus used in its laboratories to determine the Flame-Spread Index of insulation coatings.

The Flame-Spread Index is a relative measure of surface spread of flame or, conversely, resistance

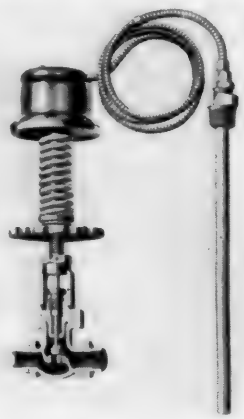


to burning in any material which may be exposed to flame or intense heat. The use of a flame spread index value will tell engineers, within narrow limits, how the flame spread hazard of finishing materials compares with well known materials such as wood and cement-asbestos board.

More Information? Circle Item 59 on Inquiry Card.

Temperature Regulator Offered

Low-cost temperature control of small loads with very low pressure differentials is made possible with a direct-operated temperature regulator developed by Spence Engineering Co., Inc., Walden, N. Y.



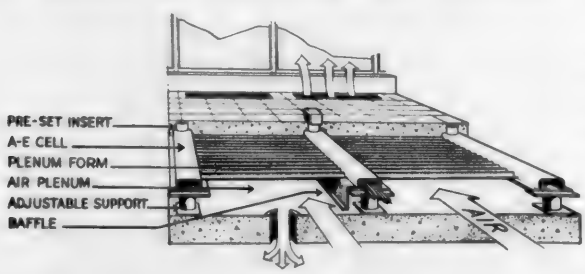
Sizes up to 2-inch are available with bronze body and union ends as standard. Responsive vapor tension thermostats are supplied for temperature ranges between the limits of 50 and 250 deg F.

Designed for control of small loads when low initial pressure limits the pressure drop across a regulator, the Type T2 regulator is specifically recommended for use when the difference between inlet and outlet pressure is less than 3 psi. Single-seat construction and stainless steel trim provide tight, positive shut-off.

More Information? Circle Item 60 on Inquiry Card.

Air-Electric Floor Introduced

Granco Steel Products Co., St. Louis, Mo., announces a floor system for building construction. Called A-E floor, the system provides for all the conditioned air and the cells for power, telephone, and other wiring. It may be used with any structural system in new construction. It is also readily adaptable for modernizing older structures.



The A-E system consists of a floor supported by the main structural slab. This floor rests on adjustable steel supports creating an air space or plenum for conditioned air to be carried to floor and ceiling air diffusers. The plenum can be varied in height, is virtually unobstructed, and can be conveniently sub-divided with baffles to provide zoning of air.

Within the floor, a network of cells at predetermined spacing carry wires for the various electrical and power circuits. Pre-set inserts are optional for connection to standard service floor fittings. Other standard electrical fittings such as header ducts, and junction boxes are applicable for use with the system.

Some of the benefits which the manufacturer claims will be derived from this system are reduction in building height, absolute level finish floor, choice of high or low velocity air systems, wide choice of mechanical systems, more effective air distribution, and electrical flexibility.

More Information? Circle Item 61 on Inquiry Card.

Roof-Mounted Heating Cooling Unit

A roof-mounted air conditioning and heating unit, employing several new engineering techniques and designed for one-story structures, has been developed by Welbilt Air Conditioning & Heating Corp., subsidiary of Welbilt Corp., Maspeth, N. Y.

The unit will be merchandised largely to shopping center stores and small one-story factory and office buildings. It is suited for the shopping center stores since it requires no valuable floor space.

The units range in size from 5 to 35 tons for air conditioning and 150,000 to 600,000 Btu for heating. They are oil or gas fired and weigh from 1,200 to 5,000 lbs. They are rust-resistant since they have aluminized steel housings, and are easily serviced.

More Information? Circle Item 62 on Inquiry Card.

Pychrometer Determines True R. H.

A portable, compact, light-weight psychrometer, designed for quick determination of the true relative humidity, is being manufactured for general commercial and industrial use by Cybernetics, Inc., Paterson, N. J. Readings of wet bulb and dry bulb can easily be taken in close proximity to critical manufacturing processes or in hard-to-get-at locations and storage places.

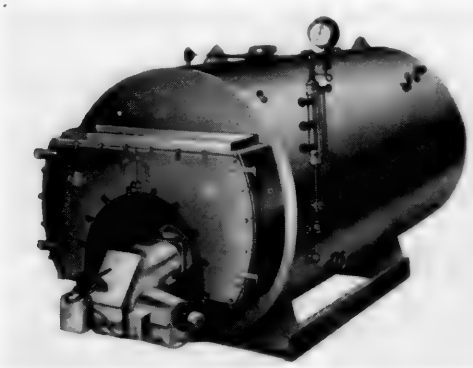
Accurate measurements may be made with the instrument in any desired position. The water supply system has a long term, refillable reservoir which wicks moisture to the wet bulb thermometer. Two standard flashlight batteries power a fan of low current drain to provide proper air circulation and evaporation. A comprehensive chart which reads the per cent relative humidity is affixed to the back side of the phenolic case. Dimensions of instrument are 2¾ x 5½ x 7 inches.

More Information? Circle Item 63 on Inquiry Card.

Forced Draft Boiler

Portmar Boiler Co., Inc., Brooklyn, N. Y., is offering a full wet-back constructed, Scotch type boiler in a compact, forced draft package which includes boiler, burner and all controls for fast economical installation.

Known as the WBS-FD (forced draft) Series, the boiler can be fired with No. 2 oil, natural, mixed or propane LP gas or combination oil-gas. Fully assembled, wired and factory-tested, units are ASME stamped. No on-the-job assembly is required. The full wet-back design eliminates the costly refractory and maintenance problems. A sealed, gas-tight smoke



box frame and door fits securely to the boiler permitting access to the tubular heating surfaces.

Claimed to produce at operating efficiencies in excess of 80%, there are 5 square feet of heating surface per boiler hp. It is available in 7 sizes, from 60 to 165 hp. Ratings range from 2,000,000 to 5,540,000 Btu. It is a low pressure boiler: 15 lbs steam; 30 lbs water. To supply year round hot water, instantaneous or tank type coils are available in a wide capacity range.

More Information? Circle Item 64 on Inquiry Card.

Close Coupled Pumps

A low-cost fractional horsepower, single stage-single suction pump for handling clear non-corrosive liquids at temperatures up to 180 deg F is announced by Allis-Chalmers, Milwaukee, Wis. Available in a range through 48 gpm with heads to 100 feet, the cast-iron pump has enclosed Delrin impellers and screwed connections.

Compact construction and lower weight are achieved by mounting the pump parts on the motor and by using the motor end housing as the pump stuffing box cover. Units can be installed horizontally or vertically by bolting motor feet to any support of suitable strength. Casings have center line discharge, are self-venting, and can be rotated to any of four positions 90 degrees apart.

The motors are standard NEMA fractional horsepower units with large deep grooved, shielded ball bearings. Horsepower ratings available range from ⅓ through 1 hp in both single and 3 phase construction at 3450 rpm. Dynamic balancing keeps noise and vibration levels to a minimum.

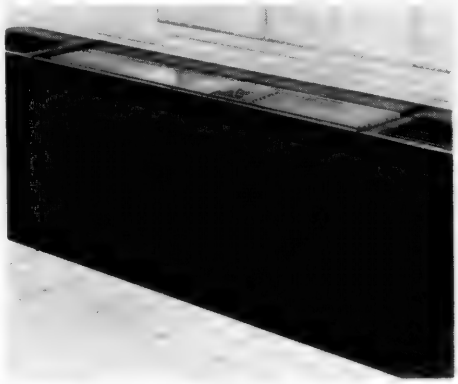
More Information? Circle Item 65 on Inquiry Card.

Zonal Air Conditioning

A new approach to zonal air conditioning, made possible by an air conditioning unit designed specifically for new construction to meet modern demands for greater capacity, lower noise levels, and longer life, has been announced by the General Electric Co., Schenectady, N. Y.

The units are available for cooling in Zoneline 42 air conditioner models and for cooling and heating combined in the Thermaline 42 heat pumps. Both chassis fit the same case and are designed to meet the requirements of high-rise apartments, office buildings, garden apartments, hotels and motels.

The zonal air conditioning system can be easily integrated with any type of heating system being considered for a building. This includes electric heating, hot water baseboard systems, the convector type and low pressure steam arrangements.



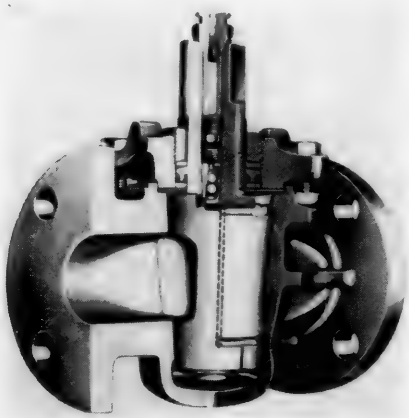
Among the features of the air conditioner is an adjustable baffle front which provides the user with alternate air direction flows. In addition, a new positive condensate water disposal system with no moving parts removes condensate by creating a miniature water spout which is blown on the condenser coil as fine mist. Both units offer quiet operation due to an oversized plenum chamber, coupled with an advanced design blower and an acoustically insulated interior baffle.

The Zoneline 42 is available in three cooling capacities: 8,000, 12,000 and 14,500 Btu per hr. The Thermaline 42 comes in two cooling heating capacities: 9,000/10,000 Btu and 13,500 cooling/14,000 heating Btu per hr.

More Information? Circle Item 66 on Inquiry Card.

High Lubricity Coated Plug Valve

A tapered plug valve design utilizing a high lubricity plastic coating that reduces turning and provides lifetime maintenance-free operation is announced by Rockwell Mfg. Co., Meter and Valve Div., Pittsburgh, Pa.



In addition to the high lubricity coatings, two other features are incorporated into the design which materially reduce the frequency of maintenance on most applications. One is a fixed adjustment assembly used on low pressure valves to maintain a constant tight seal after repeated openings and closings and to facilitate uniform turning ease. The second is designed for valves on extreme high pressure services. This consists of a threadless stem that results in a reduction of the high operating torques of conventional high pressure valves.

Valves are offered in ¼ to 36-inch sizes in all standard pressure ratings. Available in cast semi-steel, carbon, alloy and stainless steels, and non ferrous materials. For extreme high pressure service they are also available in forged steel designs.

More Information? Circle Item 67 on Inquiry Card.

Multi-Purpose Pipe Saddle

A pipe saddle, which provides a positive vapor seal at the pipe support, is announced by Insul-Coustic Corp., Maspeth, N. Y.

The new saddle, called Insul-Shield, is said to insure proper insulation thickness, provide vibration control and be corrosive proof. It is designed to provide deflection equal to approximately 20% of the free height depending on insulation thickness.

The manufacturer states that substantial labor savings can be realized by using Insul-Shield since it eliminates time-consuming adjustment of the pipe hanger before and after insulating the pipe.

More Information? Circle Item 68 on Inquiry Card.

Flush-Mounted Liquid Gages

These six flush-mounted, press fit, liquid-level gages are now available from Gits Bros. Mfg. Co., Chicago, Ill.

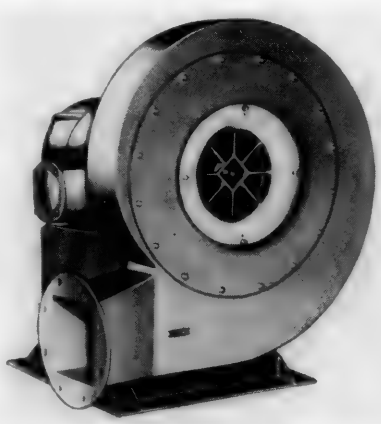
Thirty-eight styles and sizes are offered. These functionally styled gages range from simple, economical porthole windows (with or without reflector back, with or without oil level line) to column-type units which show oil level at a glance, even in dim light. The Observa-Dome, a wide angle gage, makes the oil level easy to read from both side and front.

All are factory-assembled, with windows of glass or, clear, acrylic plastic. Glass-window styles are recommended for applications of 50 psi up to 300 deg F. Plastic-window styles take 10 psi up to 100 deg, or 2 psi up to 160 deg.

More Information? Circle Item 69 on Inquiry Card.

Steel Centrifugal Air Blower

The Type W steel air blowers announced by Pyronics, Inc., Cleveland, Ohio, are designed primarily for combustion-system applications. The blowers are of welded steel, utilizing an improved design that provides extremely high efficiency. The blowers are made in capacities from 100 to 5300 cfm and may be either direct or belt driven. They are available in pressure ranges from 6 oz to 20 oz with motors up to 30 h.p.

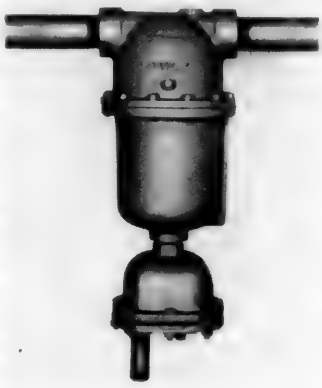


The blower case is welded steel, providing a smooth surface with minimum friction for the air flow. The air inlet in the case is streamlined for maximum efficiency and can be furnished with standard filters. The double-shroud impeller is aluminum alloy, balanced to eliminate vibration. The impeller is mounted directly on the shaft of the 3600 rpm motor, or may be belt driven. Both motor and case are mounted on a welded-steel base.

More Information? Circle Item 70 on Inquiry Card.

Low Cost Separator-Trap System

Wright-Austin Co., Detroit, Mich., has developed a low cost system for removal of oil and water from compressed air, gas and steam lines and for delivery of high purity media at the point of use.



The system, consisting of a T type separator, combined with the proper trap for the particular application, is both light weight and compact enough to be installed and supported in the line at any point. Installation of a trap alone, where the problem of entrained moisture is encountered, is not sufficient. If a separator is not used, a high percentage of moisture will by-pass and elude the trap.

Components for the system are suitable for pressures ranging from 150 to 1000 psi and for pipe sizes ½ to 8 inches. The compactness of the system permits installation near point of use, which is important, since this eliminates the possibility of further condensate developing downstream.

More Information? Circle Item 71 on Inquiry Card.

Compact, Lightweight Unit Heater

A new line of Series NF gas-fired propeller fan type unit heaters is now available from American - Standard Industrial Div., Detroit, Mich.

The units are available in ten sizes ranging in heating capacity from 25,000 to 250,000 Btu per hr input. They are recommended for automatically controlled gas heating application in factories, showrooms, garages, warehouses and other commercial and industrial installations.

The Series NF design is devoid of the usual bulk and weight associated with gas-fired units. The compact, lightweight units require a minimum of space in the working zone. Maximum headroom is achieved through the unit's low overall height.

Unit features include die-formed heavy-gauge furniture steel casing; aluminized steel heat exchanger tubes; drilled, raised-port cast iron burners; and a venturi mixing tube designed for optimum primary air injection, complete mixing of gas and air and minimum turbulence.

A summer-winter switch is provided for operation of fan for summer ventilation as a standard part of the unit.

More Information? Circle Item 72 on Inquiry Card.

Butterfly Valve Introduced

Mid-Continent Metal Products Co., Chicago, Ill., introduces a new butterfly valve, suitable for control of either air or gas flow up to 5 psi pressure and with capacities to 20,000 cubic ft per hr natural gas. Either manual or automatic valves are available in seven pipe sizes from 1 through 4 inches.

The valve is distinguished by special features, yet has a simplified design which has reduced the cost. It is a low pressure drop unit with a streamlined, properly sized throat to allow sensitive control of normally used capacities. A 90 degree closing valve allows easy synchronization with shutters using suitable linkage. Ease of adjustment is permitted by a spring over-run feature. Upper and lower limits are set by stop screws regardless of motor stroke. No involved linkage adjustments are necessary.

More Information? Circle Item 73 on Inquiry Card.

Suspended Furnace Line Increased

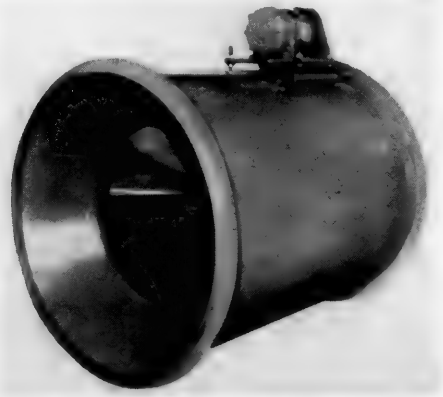
Five larger size suspended furnaces, ranging in capacity from 85,000 to 335,000 Btu, is announced by Quiet Automatic Burner Corp., Newark, N. J. They have 12 gauge primary and secondary heat exchangers with stainless steel combustion chambers. Larger blowers have been added, increasing the cfm. Furnaces are made either standard or reverse flow, and can be easily changed on the job by switching the heat exchanger.

More Information? Circle Item 74 on Inquiry Card.

Improved Centrifugal In-Line Fans

Directional flow wheels and other improvements are incorporated in a new series of centrifugal in-line fans with quieter operation and high efficiency by Dryer Dynamics Corp., Lyndhurst, N. J.

Available for volumes up to 300,000 cfm and static pressures up to 15 inches, the fans are built in Class I through V constructions for high-pressure and conventional air conditioning, ventilation, and indus-



trial process applications. They combine centrifugal-fan performance with the compactness and ease of connection of tubular fans.

Engineered specifically for centrifugal in-line operation, the fans have an aerodynamically-designed centrifugal wheel with die-formed blades and shroud. The wheel imparts centrifugal motion to the air and then diverts it to axial flow within the impeller, minimizing turbulence and improving efficiency.

More Information? Circle Item 75 on Inquiry Card.

Dual Control System

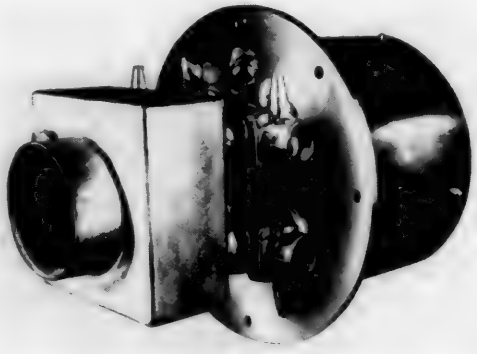
For new and existing office building air conditioning systems, Remington Air Conditioning Division, Remington Corp., Auburn, N.Y. has developed an air conditioning system to provide comfort for tenants who work after hours or weekends, without wasteful operation of the entire system. A programming clock starts and stops the entire system week days, at desired hours. Triple over-riding dual control provides after-hour or week-end push-button restarting of individual zones by tenants, followed by periodic shut-down by programming clock.

More Information? Circle Item 77 on Inquiry Card.

Burner Features Short Flame

The 2004 NM and 4004 NM multiple tunnel burners announced by Pyronics, Inc., Cleveland, Ohio, are high capacity burners featuring short flame lengths for firing into restricted areas and/or pressurized combustion chambers. Four separate flame tunnels result in a much shorter flame length (only 2 feet) and higher heat release than can be achieved with a single burner of equal capacity.

Individual flames can be controlled to provide a turndown capacity of 40/1. With 4 oz inlet combustion air pressure and 4 to 28 inches of water inlet gas pressure, the 2004 NM burner has a range of 50,000 to 2,000,000 Btu per hr; the 4004 NM has a range of 100,000 to 4,000,000 Btu per hr. Capacities can be increased up to 70% with higher air and gas pressures.



A single air inlet enters the central manifold chamber which distributes combustion air to all four gas-air mixers. Fuel is fed to each mixer from individual gas inlets. The burners will burn any standard fuel gas. Each tunnel has a stepped burner block to provide positive flame retention and shorter flame length, even at high mixture pressures. Dimensions of the 2004 NM are 18-inch dia by 22 inches long. The 4004 NM is 20-inch dia by 24 inches long. Shield length is an additional 18 inches.

More Information? Circle Item 78 on Inquiry Card.

Gages Feature Polypropylene Rings

Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville, Tenn., announces a development which is being made a standard feature for some models of its Acragage line of pressure gages.

A bezel assembly consisting of a polypropylene ring, which snaps tightly into the case front, is offered as standard construction for phenolic case gages. The ring also can be furnished on aluminum and cast-iron cases. The full area rear blow-out disc also is made of polypropylene.

The polypropylene ring assembly eliminates problems encountered with snap rings, which make replacement of the lens a difficult task. The lens is retained in the new ring in such a way as to prevent removal, but in case of accidental breakage, a new lens can be installed easily. Corrosion problems which are often encountered in petroleum refineries and chemical plant applications are believed to be eliminated.

More Information? Circle Item 76 on Inquiry Card.

Freeze-proof Post Hydrant

Josam Manufacturing Co., Michigan City, Ind., has added several features to its line of wall and yard hydrants in development of the Series No. 1440 post hydrant.

According to the manufacturer, the unit delivers maximum flow with a minimum of pressure loss regardless of temperature, assuring a dependable adequate supply of water the year around.

The heavy cast aluminum housing is protected with weather resistant enamel, while the operating parts are made of bronze alloy to minimize wear and eliminate corrosion.

The rod and plunger mechanism do not rotate and the screw mechanism cannot be disengaged. The combination brass and molded neoprene plunger assure a positive seal. These features plus exacting manufacturing tolerances, states the maker, provide long, trouble-free service.

Circle Item 79 on Inquiry Card.

Solenoid Valves for Refrigerants

"Normally Open" solenoid valves, specifically for use with refrigerants 12, 22, and 500, are announced by Jackes-Evans Manufacturing Co., St. Louis, Mo.

The complete line of valves, with either a-c or d-c waterproof epoxy-clad coils, is available in port sizes from ¼ to 1¼ inches with either pipe or sweat connections.

This new design answers the need for this type of valve on many refrigerant applications where valves of this type were previously unavailable, the firm reports. Using a normally-closed valve on such applications made it necessary to use reversing relays to achieve a normally-open action.

Circle Item 80 on Inquiry Card.

MAID-O-MIST Inc.
HEATING SPECIALTIES

automatic

AUTO-VENTS®

They vent air CONTINUOUSLY in (hydronic) hot water heating and chilled water cooling systems

No. 27 is 3" x 2½", with ⅛" I.P. Female side connection

No. 37 for horizontal mounting only, 3" x 2½" with ⅛" I.P. vertical male bottom connection

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for

HORIZONTAL MOUNTING

on

- Combination heating & cooling convectors
- Fan coil units
- Radiant panels
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FOR PRESSURES UP TO 50 LBS.

Simply designed, they do a most effective job of getting rid of air pockets, letting the water circulate freely, automatically, thanks to a reliable float valve. Learn more about these inconspicuous vents that cost so little — yet do so much!

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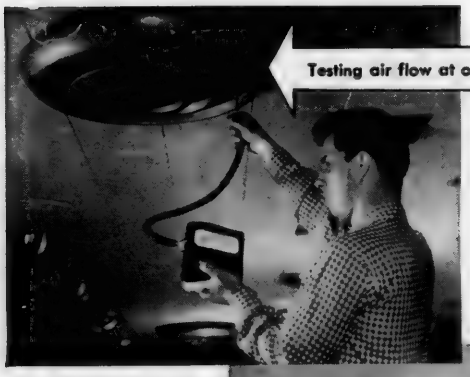

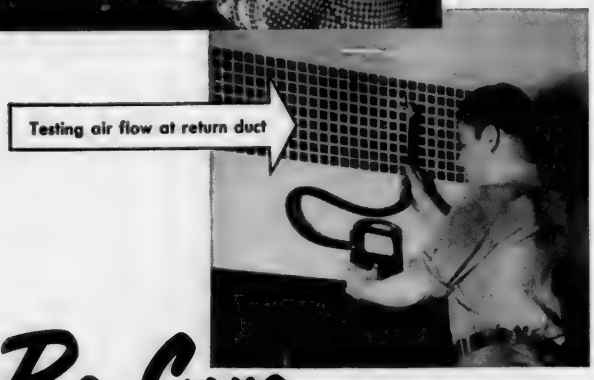

Be Sure the first time
in balancing air flow systems

The Alnor Velometer®

gives a quick accurate check of air movement at outlets, returns, plenum chambers, static pressure in ducts, friction loss at ells and deflectors.

Readings are made directly in f.p.m. on the Velometer dial. So sensitive, readings as low as 20 f.p.m. can be made. The triple range scale registers up to 3000 f.p.m. and 6000 f.p.m.

Velometer Set No. 3G

Recommended for the air conditioning, heating and ventilating contractor. Consists of the Velometer with rugged carrying case, angle supply jet, suction (return) jet, static pressure jet, Price f.o.b. Chicago $194.

Velometer Jr.

For quick simple checking at outlets where attachments are not required. A compact instrument only 4" x 3" x 1½". Capacity ranges

0—200 f.p.m. to 800 f.p.m.
0—400 f.p.m. to 1600 f.p.m.
0—500 f.p.m. to 2500 f.p.m.

Price, with genuine leather carrying case, $44.00 f.o.b. Chicago. All models carried in stock for immediate delivery.

Alnor INSTRUMENTS

ALNOR INSTRUMENT CO.
Division of
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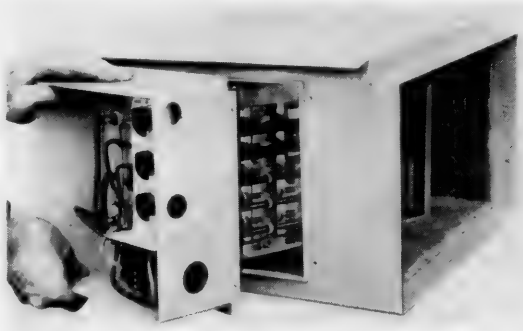
Rm. 570, 420 N. LaSalle St., Chicago 10, Ill.

Electric Duct Heaters

Thermador Electrical Mfg. Co., Div. of Norris Thermador Corp., Los Angeles, Calif., introduces a line of electric duct heaters for universal application. They are designed for use as supplemental heaters in heat pumps, as air heaters in ventilating systems, or in conjunction with straight air conditioning units.

The easily installed duct heaters are available in six, eight, and twelve kilowatt units for single or three phase 240 volt service; 208 volt or 480 volt elements are available on special order.



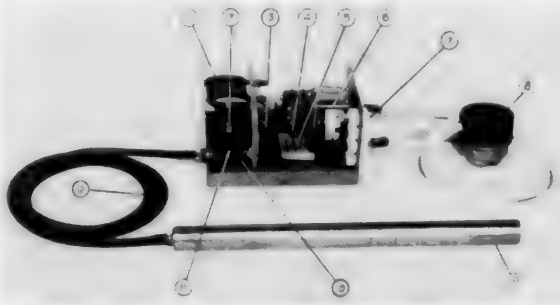
Each heater includes a main contactor, a combination automatic reset limit and duct control, a low voltage terminal strip, and a plate-mounted control voltage transformer. Provisions are made for multiple staging by simple installation of up to two additional ductstats.

More Information? Circle Item 81 on Inquiry Card.

Control Defrosts Heat Pumps

D. H. McCorkle Co., Berkeley, Calif., announces a field tested de-ice control, Model G-171, which calibrates itself to maintain maximum operating efficiency of heat pumps.

This self calibration takes into consideration all of the factors affecting the heat pump and comes up with a calibration point to meet the integrated conditions of: ambient temperature, barometric pressure, relative humidity, condition of the outdoor coil, performance of the blower, and condition of the air filter in the indoor air distribution system. It can tell how many registers are open in the circulating system and even does its job in freezing rain.



More Information? Circle Item 82 on Inquiry Card.

SO VERY, VERY QUIET

BOHN-AIRE ROOM CONDITIONERS

SO QUIET
Bohn-Aire
SO EFFICIENT

Write for BOHN Bulletin 250 containing full details

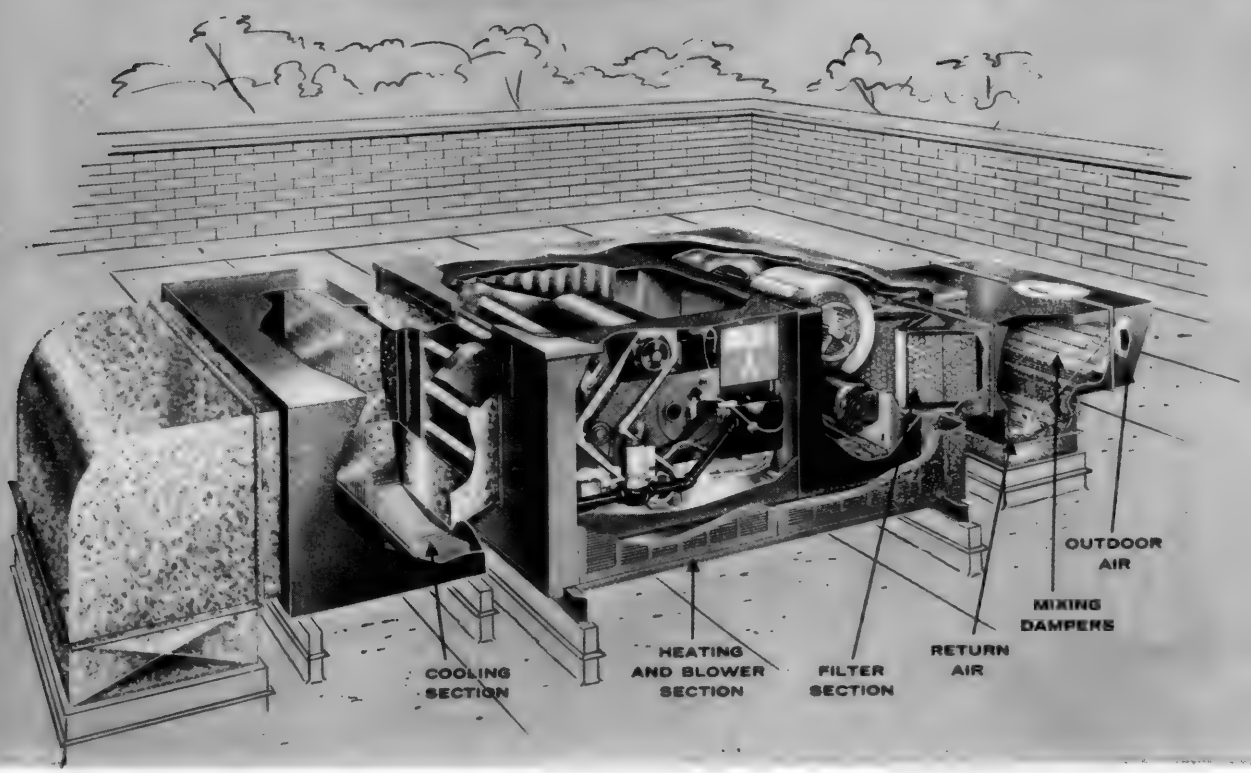
BOHN

Buy the known line... the BOHN line

ALUMINUM & BRASS CORPORATION

Danville Division • Danville, Illinois

new from LENNOX



outdoor units FLEXIBLE enough to handle any heating–cooling–ventilating job

Flexibility of use

1. Heating-cooling-ventilating with manual or automatic dampers for outdoor air.
2. Heating and ventilating with or without filters and with manual or automatic dampers to proportion fresh air and return air.
3. Heating only, with or without filters.

From a space-saving roof top or ground slab installation, use this equipment as a central unit . . . or in multiples to serve different areas. Each section is completely weatherproofed and insulated. Sections come completely assembled, ready to be bolted to each other.

Flexibility of output

280,000 to 1,000,000 Btuh heating.

Air volume of 3,000 to 15,000 cfm.

8 to 35 tons cooling (installed initially or added later).

Can serve up to 20,000 sq. ft. of floor space.

Flexibility of fuel

Gas, oil or combination burners with either manual or automatic fuel changeover.

Low silhouette

Even the *largest* unit is only 58″ high installed. This includes flue outlet. Induced draft combustion system is built-in, eliminating a conventional flue.

"Free" cooling

Many days of the year, cooling is needed in a building even though outdoor air temperature is relatively low. In these cases, Lennox equipment brings in large volumes of outdoor air to cool the building without operating the cooling compressor . . . a big saving.

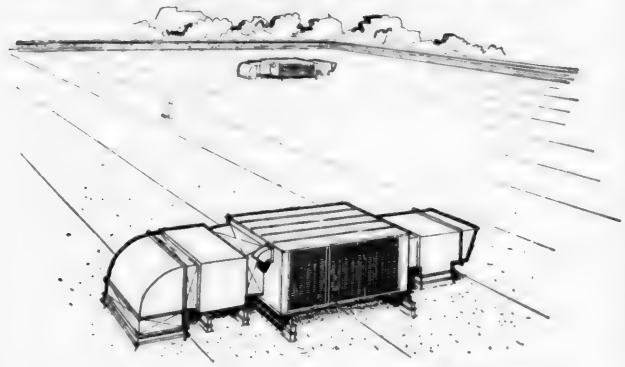
LENNOX a single source for heating, ventilating, air conditioning

Don't be satisfied with less than

LENNOX

on the

BIG JOBS



On big jobs, the so-called "little things" are still mighty important... things that add up to highest quality, extra convenience. Here are a few more reasons for specifying Lennox on your next job:

- *Exclusive Lennox-designed controls.* You get equipment *and controls* from one source. Room-mounted control center includes thermostat and convenient minimum position control for dampers.
- Protective service cavity for burners; a maintenance man's joy.
- Stainless and aluminized steel in heat exchangers and the combustion and induced drafts blowers. (Blowers welded to shaft to prevent slipping.)
- Refrigerant is sub-cooled in air-cooled condensing units. This, plus extra cooling coil surface, results in efficiency comparable to costlier water-cooled units.
- Time-tested components, proved in hundreds of installations throughout the world.

The complete Lennox line, and your Lennox representative, will make your designing and buying job easier . . . one central source for direct-fired heaters up to two million Btuh . . . cooling and ventilating for any job.

Don't be satisfied with less than

LENNOX

HEATS, COOLS, TREATS AND MOVES AIR

LENNOX INDUSTRIES INC., EST. 1895—MARSHALLTOWN, IA.; COLUMBUS, O.; SYRACUSE, N.Y.; DECATUR, GA.; FT. WORTH, TEX.; SALT LAKE CITY, UTAH; LOS ANGELES, CALIF. LENNOX INDUSTRIES (CANADA) LTD.—TORONTO, MONTREAL, CALGARY, VANCOUVER, WINNIPEG.

Low Voltage Control System

A compact low-voltage control system for electric heat, called Level-Temp, is announced by White-Rodgers Co., St. Louis, Mo. The system has two components; a sensitive thermostat provides narrow differential control through a silent operator, which handles the line voltage heating load.

Designed for use wherever low voltage control of electric heat is desired, Level-Temp is ideal for controlling such installations as in-duct heaters, wall insert heaters, blast-coil heaters, baseboards, floor register heaters, unit ventilators, and auxiliary heaters of heat pumps.

The thermostat has straight-line styling, is heat anticipated for fine performance, and features sealed mercury contacts. Level bubble in mounting plate assures quick, accurate installation.

The silent operator has both a male conduit hub and mounting tabs, making it adaptable to both horizontal and vertical mountings. The male conduit hub permits mounting directly to a junction box or wiring enclosure, where all line voltage wiring can be performed. Because of its compact size and silent operation, it can also be mounted on the side of ducts, within wall and ceiling heaters, inside baseboards and their control sections, remotely in an attic or between floor joists, or in other desired locations.

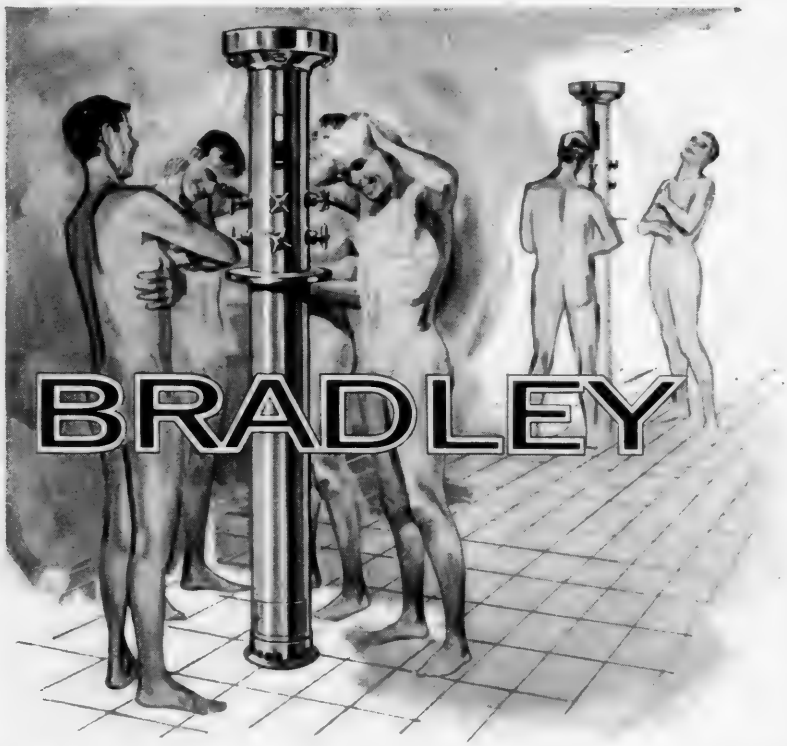
More Information? Circle Item 83 on Inquiry Card.

Refrigeration Desiccant Announced

A desiccant specifically designed for service in refrigeration systems is being produced by Linde Co., Molecular Sieve Products Dept., Division of Union Carbide Corp., Tonawanda, N. Y.

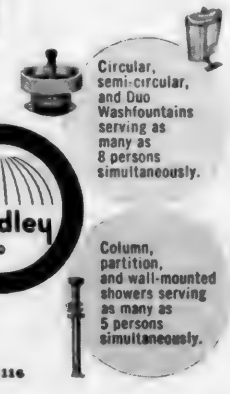
The desiccant, molecular sieve 4A-XH beads, represents a considerable technical advancement over all other types of desiccants previously available for refrigeration service, the company claims. The product retains the high capacity of the original beads for both water and acid, while combining several improved characteristics requested by the industry. These include: Over ten times less R-22 decomposition than the original product, three times greater resistance to attrition, twice the crush strength, and 10% higher bulk density.

More Information? Circle Item 84 on Inquiry Card.



Most Complete Line of Group Showers

Save space, water, installation costs, and maintenance time. Speed traffic flow, too! And look at the variety you can choose from: 2, 3, and 5-person Column showers 5-person Multi-Stall shower 3-person Semi-Circular Multi-Stall shower 2-person Corner shower 2 or 3-person Wall-Mounted showers Custom Panel showers.


Circular, semi-circular, and Duo Washfountains serving as many as 8 persons simultaneously.
Bradley
Column, partition, and wall-mounted showers serving as many as 5 persons simultaneously.
61-116

Bradley Washfountains and showers provide group facilities for as many as 8 and 5 persons, respectively, in schools and in commercial, industrial, and public buildings. For additional information, contact your Bradley representative. Or write for Catalog No. 6004. Bradley Washfountain Co., 2352 West Michigan St., Milwaukee 1, Wisconsin.

(Continued from page 16)

LIQUEFIED NATURAL GAS MAY BE SHIPPED FROM ALASKA

A possible new method of transporting natural gas was introduced to delegates to the 68th Pacific Coast Gas Association meeting in Coronado, Calif.

John R. Fraser, Union Oil Company official, explained how gas would be cooled to minus 260 deg F, condensed into a liquid 1/630 of its original volume, moved 2500 miles by specially insulated tanker and then reheated and returned to its original state, ready for use.

The gas reserves referred to are in Alaska. Union Oil discovered the reserves in 1959. Mr. Fraser dwelled upon the technical aspects of shipping the liquefied gas to California.

COLUMBIAN ENGINEERING DEAN SCORES "MYOPIC HUMANISM"

Engineers and scientists are distributed by a "myopic humanism" that is prevalent among educators and statesmen and which excludes the physical sciences as beneath its dignity. Writing in *Engineer*, publication of Engineers Joint Council, John R. Dunning, Dean of Columbia University's Engineering School scored this attitude as untruthful and misleading and in today's world.

The text of Mr. Dunning's article follows:

No major discipline has changed more rapidly, acquiring entire new areas of competence and of responsibility, than engineering has since the Second World War. Each new development in chemistry, physics, and mathematics has very soon had its effect on engineering; and in addition, the approach of the engineer to his intellectual resources has changed.

Less Handbook Engineering

The secular trend in professional engineering has been away from the routine applications of

(Continued on page 134)

CLOGGING by high wet-strength paper products is IMPOSSIBLE!

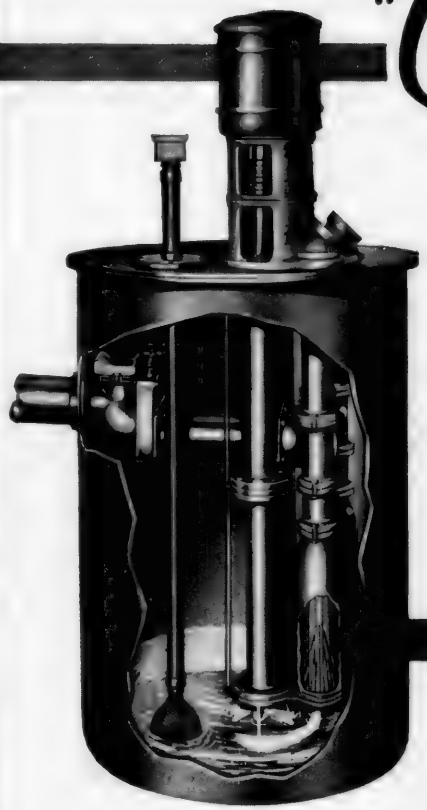
with the new FLUSH KLEEN® system from "Chicago"

This clogging cannot happen with the FLUSH KLEEN System

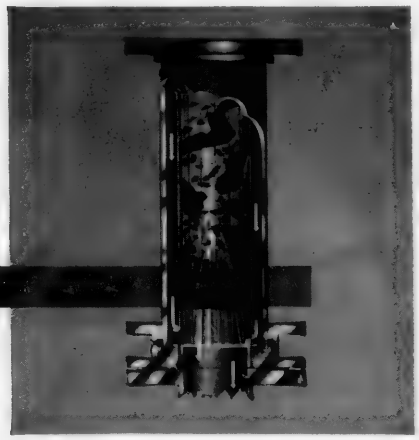
CLOGGED— Paper toweling piled up at eye of 2½" sphere design impeller.

CLOGGED— Complete clogging of 2½" sphere design impeller.

CLOGGED— Complete clogging of 3" sphere non-clog impeller.



THE FLO-THRU STRAINER, heart of the Flush Kleen system continuously permits only clear liquid to flow through the strainer into the pump at highest solids loadings.



SOLIDS NEVER REACH THE IMPELLER

Impeller handles only clear liquid. Shaft, bearings and motor are never subjected to severe strain and wear due to partially or completely clogged impellers. The life of a Flush Kleen system is therefore much longer than that of so-called non-clog type pumps. "Down time" due to clogging is eliminated and a quiet, smooth operating unit is assured.

For further information see your local Chicago Pump distributor or write Chicago Pump for Bulletin 122-D.

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fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION

CHICAGO PUMP

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INCREASE EFFICIENCY AND DECREASE COSTS WITH METROPOLITAN MAINTENANCE PRODUCTS

DUBOTH®
BOILER FEED WATER TREATMENTS
VAPORENE®
AIR CONDITIONING WATER TREATMENTS
SLUDGOUT®
FUEL OIL ADDITIVE FORMULATIONS
SOOTRACIDE®
SOOT AND SLAG ELIMINATOR
EZ TREAT®
COMPLETE TREATMENT FOR SMALL AIR CONDITIONING
DESCALER®
AIR CONDITIONING AND BOILER SCALE REMOVERS
CORRODINE®
STEAM & RETURN LINE TREATMENT
CORRODICIDE®
TREATMENT FOR GENERAL WATER SUPPLY SYSTEMS

As They Have For 40 Years, Engineers Everywhere Today Rely On METROPOLITAN'S Quality Chemical Maintenance Products And Consulting Services.

Through Scientific Field Surveys And Laboratory Analyses METROPOLITAN Works Closely With You To Find The Right Answers To Your Specific Problems.

To Prevent Or Eliminate Problems Of Scale, Corrosion, Slime, Soot, Slag, Sludge Caused By Impurities In Water And Fuels . . . In Boilers, Cooling Towers, Evaporative Condensers, Storage Tanks, Steam & Return Lines, General Water Supply Systems . . . In Industrial Plants, Office Buildings, Apartment Houses, Public Institutions, Hotels, Theaters, Stores . . .

ASK FOR THE MAN FROM METROPOLITAN. HE HAS THE CHEMICAL SOLUTION FOR YOU.

See our Representative in your area or write us for complete information.

METROPOLITAN REFINING CO., INC.
50-23 TWENTY-THIRD STREET
LONG ISLAND CITY 1, N.Y.

(Continued from page 132)

recorded empirical knowledge, towards the creative use of basic hypotheses purposely developed from scientific investigation — that is, away from the handbook and towards research.

This change has been particularly marked in America, as compared with continental Europe, because in America the distinction between engineering and pure science was formerly greater. Three generations ago a large proportion of our men in pure science were imported and were the object of snobbish veneration by those who considered Europe truly cultured and their own country crude and pragmatic; while the engineers were the heroes of an inverted snobbery deriving the practical and latently anti-intellectual cult of the frontier. The former attitude left an enduring impress on the American university tradition; the latter attitude left a (fortunately) more transistory impress on the engineering profession.

There is still an important difference between what the engineer does and what the pure scientist does, but it is less than it was; and the distinction between how the engineer is educated for what he does and how the scientist is educated for what he does is less yet.

"Myopic Humanism" Defined

We who have spent our professional lives on the frontiers of verifiable knowledge are often disturbed to see how little that revolution has affected the world-picture of even the most sophisticated educators and statesmen. Among these men a view persists, derived perhaps from nineteenth-century horror at the depredations of materialism on orthodoxy, that could be called "myopic humanism." Myopic humanism holds that the supreme accomplishments of human life—art and philosophy —are somehow nonphysical, and therefore superior to the understanding and manipulation of physical environment, which is

(Continued on page 136)

PITTSBURGH HILTON HOTEL, Pittsburgh, Pennsylvania. Architect: Wm. B. Tabler, N.Y.C.; General Contractor: Turner Construction Company, N.Y.C.; Mechanical Engineers: Jaros-Baum-Bolles, N.Y.C.; Plumbing Contractor: Sauer, Inc., Pittsburgh.

130,000 lbs. of water lines!

Anaconda copper tube up to 8" throughout

There are many reasons why Anaconda Copper Tube is so often the choice for modern water supply and drainage systems. It is, for example, extremely easy to handle in limited work spaces. This, of course, helps keep initial costs low. Add such advantages as long life and trouble-free maintenance and you have a material mighty hard to beat.

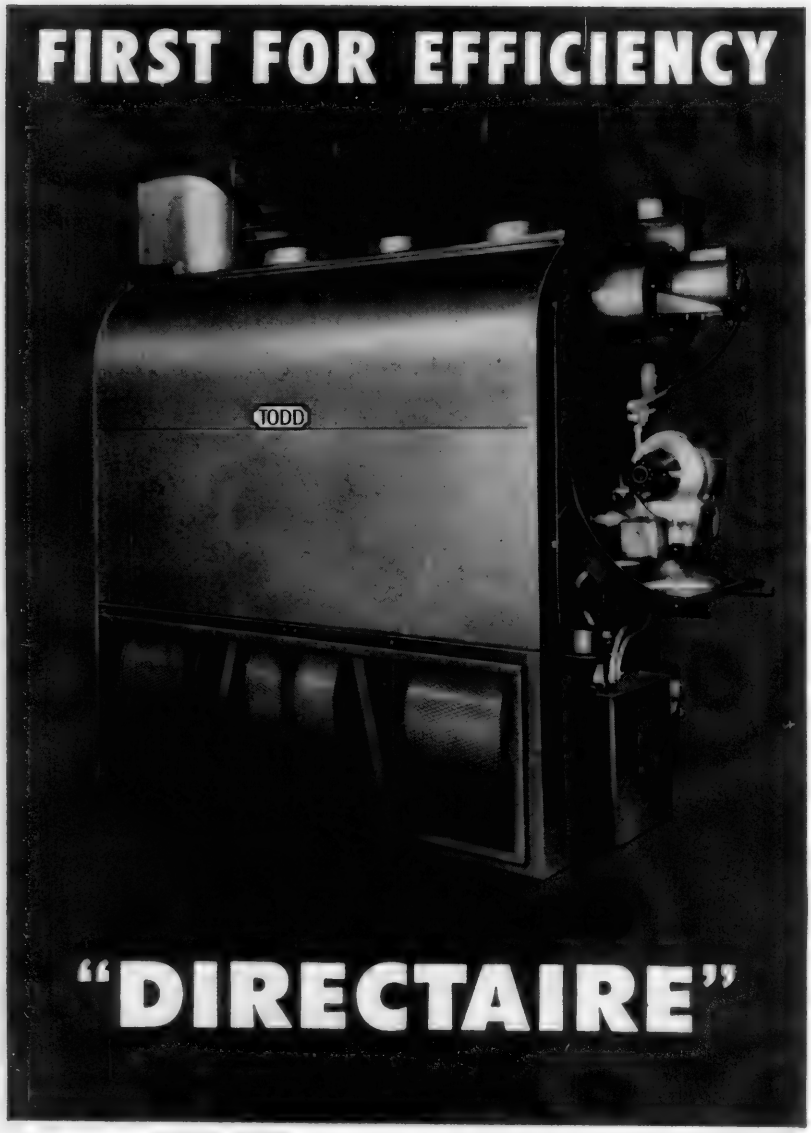
For complete information about Anaconda Copper Tube and Fittings for general plumbing, heating, air conditioning and refrigeration, write for free copy of Publication B-1, Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

61-1027

ANACONDA®
AMERICAN BRASS COMPANY

In the new Pittsburgh Hilton the hot, cold and chilled water supply is delivered by 130,000 lbs. of Types K and L Anaconda Copper Tube in sizes to 8".

FIRST FOR EFFICIENCY



"DIRECTAIRE"

COMPLETE SINGLE PACKAGE UNIT

LOWEST-COST HEATING

•

HEATING & VENTILATING

FACTORIES • WAREHOUSES
OFFICES • STORES
GARAGES • INSTITUTIONS
MANUFACTURING PROCESSES

FLEXIBILITY at minimum cost—as completely self contained heating system or in conjunction with existing heating and air conditioning (same ducts can be used). Easy installation, floor or overhead, with fully wired control panel ready to connect.

TROUBLE-FREE performance with high efficiency output of warm air and ventilation at correct sustained volume. For every type of space heating or for manufacturing processes under strict thermostatic control, "DIRECTAIRE" is the system with "built-in" economy.

WRITE FOR "DIRECTAIRE" BOOKLET 30X

TODD PRODUCTS

A DIVISION OF TODD SHIPYARDS CORPORATION

Sales and Engineering: Columbia and Halleck Sts., Brooklyn 31, N. Y.
Manufacturing: Green's Bayou, Houston, Texas

News of the Month

(Continued from page 134)

after all only a kind of clever housekeeping that makes the life of the spirit possible. Too many, even now in the age of man's transcendence of space, see nothing wrong in a "humanism" that excludes, as beneath its dignity, the physical sciences that once had honored places among the seven liberal arts.

It is surely a provincialism of the intellect to hold that a man who knows history, literature and foreign languages, but not mathematics, physics, and biology, is an "educated man." Because the language of words, through which we can know the first three, is used by all university students, while the language of mathematics, through which we know the last three, is not, it can even be said that the student of the physical sciences, traditionally scorned by the devotees of myopic humanism, is much closer to being an educated man.

New Society Emerging

We live in an age during which a radically new form of society may be emerging, based on an explosion of science and technology that could completely alter the environment to which man, in a million years of painful evolution, has adapted his physical and mental make-up. How valid, therefore, is a politics that tries to guide itself by analogies to past societies based on slavery, military conquest, feudalism, and colonial exploitation? How valid is an aesthetic which is only vaguely aware of the mechanism of the senses and the physiology of the emotions? How valid is a literature which is ignorant of the intellectual life of the man of science? How valid are all our speculations on "human nature" when they are but ill-digested lumps of a prior reasoning from premises that we derive from tradition, and the deep unconscious?

Advise Curricula Changes

We can no longer afford the arbitrary division in university education between the "truths of

(Concluded on page 138)

Check the Refrigerant at a Glance...

with a SPORLAN *See•All*

the Moisture and Liquid indicator with the single dot that shows how dry the refrigerant is... and the full view sight glass that lets you see if the system is fully charged.

Check these See•All advantages too...

One indicator with the same color change for Refrigerants 12, 22, 40 and 500. Color change points for each refrigerant reliably and accurately calibrated in parts per million of moisture content. Color changes are reversible and easily distinguished...dark green indicates dry, and bright yellow wet. The largest, crystal clear, full view sight glass. Color indicator protected from discoloration and dirt in the system. Disassembly not required for installation. Double gasket at sight glass assures a positive leakproof joint. Double duty plastic cap keeps dirt and curiosity out. By-pass kits available for economical installation on large liquid lines.

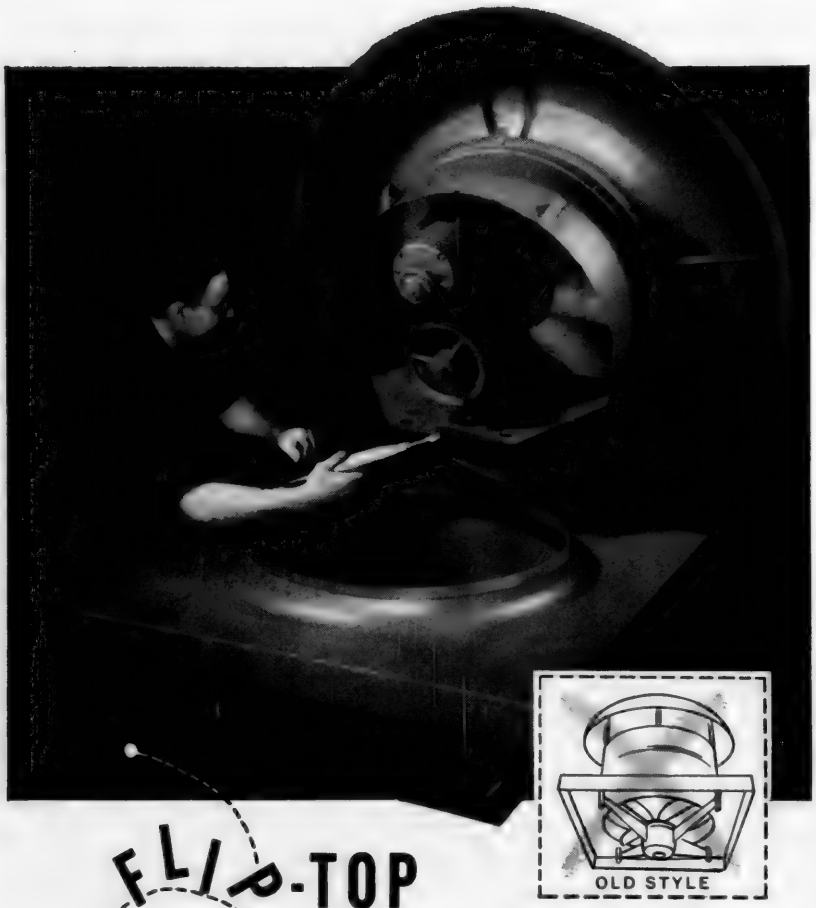
Get Peak Performance on every installation . . . make Sporlan See•Alls a must on your next order. See your Sporlan Wholesaler and ask him to show you the See•All line, or write for bulletin 70-10.

⅞" and 1⅛" ODF sweat models now available

SPORLAN VALVE COMPANY

7525 SUSSEX AVENUE ST. LOUIS 17, MISSOURI

Export Department 85 Broad Street, New York 4, New York



FLIP-TOP
ROOF VENTILATOR
cuts Maintenance Cost

Entire motor-and-fan housing may be flipped back 90° to make motor, drive assembly and fan conveniently accessible above roof level. Such easy access to all working parts for quick inspection cuts maintenance costs substantially by saving time and making the work easier.

This new DeBothezat "flip-top" Power-Flow roof ventilator offers fan wheels from 12" to 48" in diameter and capacities to 43,070 CFM. A Vertical Discharge Model exhausts dust and oil-laden air at high velocity, to disperse contaminants high enough to prevent their re-entry into building's air supply.

Write for illustrated Bulletin DR-7-61

De Bothezat®
DE BOTHEZAT FANS DIVISION OF
American Machine and Metals, Inc.
Dept. ACH-1161, EAST MOLINE, ILLINOIS

Divisions of American Machine and Metals, Inc.

TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • AUTOBAR • AUTOMATIC DEVICES • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION

(Concluded from page 136)

the spirit" and the "truths of matter." It may well be that rational inquiry into the physical universe has its inherent limits, and that some activities of human life cannot be understood by mere reason; but we do not yet surely know what those activities are. The man who thinks that his knowledge of the humanities is complete because he knows something of the history of science is deluded. He is a shallow humanist indeed who thinks he knows the principles of matter and energy because he is aware of some striking analogies between Greek science and modern physics.

CALLS FOR FIRM PRICING IN PLUMBING INDUSTRY

In an address before the 10th annual convention of the American Institute of Supply Associations, T. M. Evans, chairman of Crane Co., said that the present industry practice of granting below-wholesale prices on products used in large commercial and residential projects constituted a threat to the existence of the wholesaler system of distribution.

Mr. Evans said that manufacturers and their wholesalers suffered financially from special job pricing wherein wholesalers ask manufacturers to outbid each other on large projects. A continuation of the practice, he added, can reduce the wholesaler function to that of an order taker and endanger the economic justification for a wholesaler's discount.

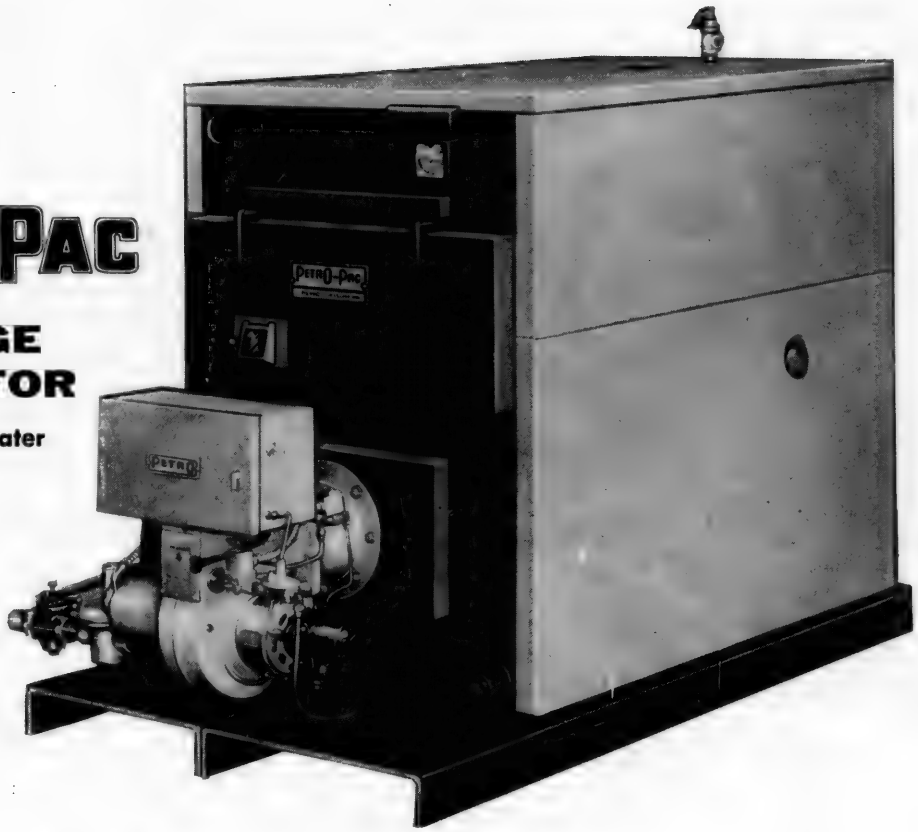
Mr. Evans said that Crane Co. had tried to establish firm pricing schedules which gave wholesalers the same price whether buying for their own inventory or for a special project, but that it could not be maintained because wholesaler acceptance was lacking. He estimated that members of the American Institute accounted for up to 50% of all plumbing, hydronic heating, valves and fittings sold in the United States and pointed out that the individual needs and desires of Institute members could certainly influence the policies of manufacturers who were their suppliers.

NEW

PETRO PAC

PACKAGE GENERATOR

steam or hot water



WHEN YOU SELECT A NEW HEATING PLANT

are these your problems?

Your building does not have a stack or chimney, or the draft conditions are poor Forced draft firing makes natural draft chimney or stack unnecessary. With PetroPac only an exhaust vent is necessary.

You must keep maintenance to a minimum Troublesome maintenance of buckling, spalling refractory sidewalls is eliminated. New design burner head does not require heat reflecting refractory to support combustion.

You want to avoid divided responsibility among different manufacturers and contractors PetroPac is a complete package. No separate contracts.

The unit you select must stop standby loss PetroPac sealed combustion, forced draft design stops cold air from circulating through combustion chamber; eliminates heat wasting refractory sidewalls—standby loss is negligible.

You must reduce on-site assembly labor costs PetroPac package is factory assembled and tested, ready for service connections.

Your boiler room ceiling is low Old style boiler base is eliminated. PetroPac reduces the height of the base from as much as 3 feet to 3 inches.

Mail coupon for complete literature and specifications on the new PetroPac package generator

PETRO

T. M. REG. U. S. PAT. OFF.

Makers of quality heating and power equipment since 1903

Petro, 3312 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto)

Please send me literature and specifications on dependable PETRO steam and hot water generators.

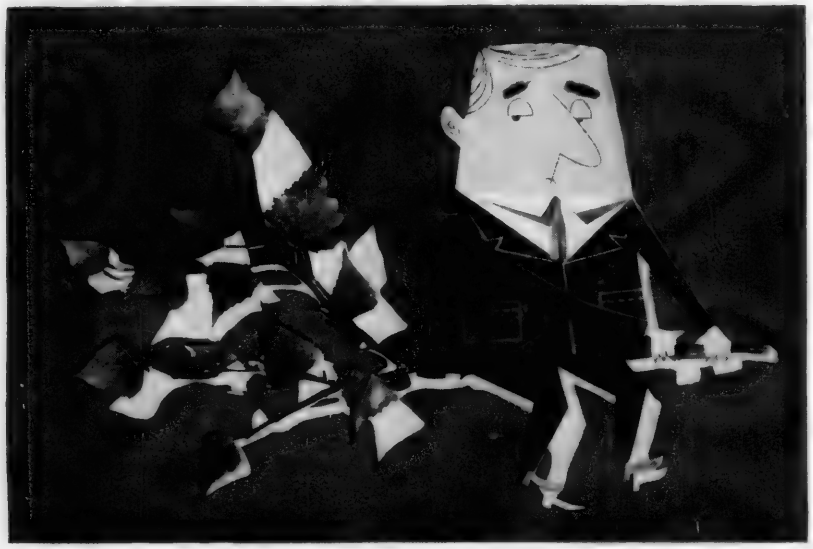
Name_____

Firm_____

Address_____

City_____ State or Prov._____

Don't Get out on a LIMB...

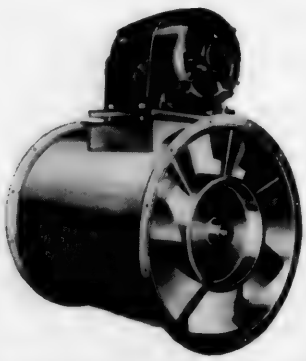


insist on the vaneaxial blowers

which are designed specifically

for rough, tough industrial service

...HARTZELL VANEAXIAL BLOWERS



Compare the specifications on Hartzell Vaneaxial blowers with those on other units of the same type. Note for instance the heavier gauge steel used on the Hartzell units, the heavier over-all construction, the fact that Hartzell welds the guide vanes to both the inner and outer shells. You'll quickly see why Hartzell vaneaxial blowers stand up better . . . last longer, require less maintenance. And Hartzell vaneaxial blowers are now available in eleven sizes, 12" to 60", including the one that's just right for your application.

BRIEFLY STATED

NEWS ITEMS

The Bureau of Labor Statistics recently announced that costs of materials used in the construction of public schools amount to $555 for each $1000 of construction contract. Statistics of interest to ACHV readers are: $58 of each $1000 for electrical products; $51 of each $1000 for heating and ventilating equipment, including air conditioning; and $34 of each $1000 for plumbing products. (Source: RACCA *Newsletter.*)

WITH THE ENGINEERS

A consulting engineering firm, KOTON AND DONOVAN, has been formed, and will specialize in mechanical and electrical engineering in the air conditioning, refrigeration, heating, plumbing and electrical fields. The company office is at Crossroads Plaza, West Hartford, Conn. . . .

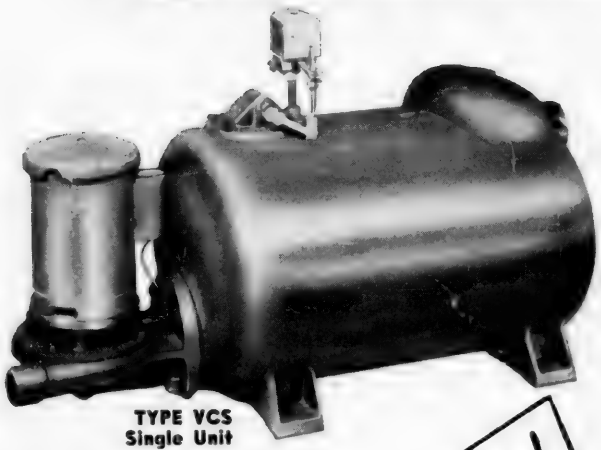
Edward J. Brown, former research assistant professor of mechanical engineering at the University of Illinois was appointed research engineer at the Titus Research Laboratory, TITUS MFG. CORP., Waterloo, Iowa. While at the University of Illinois, Mr. Brown was principal investigator on a number of projects—including an investigation of dampers used in large duct systems, and the National Warm Air Heating and Air Conditioning Association's residential year around air conditioning project.

ASSOCIATION ITEMS

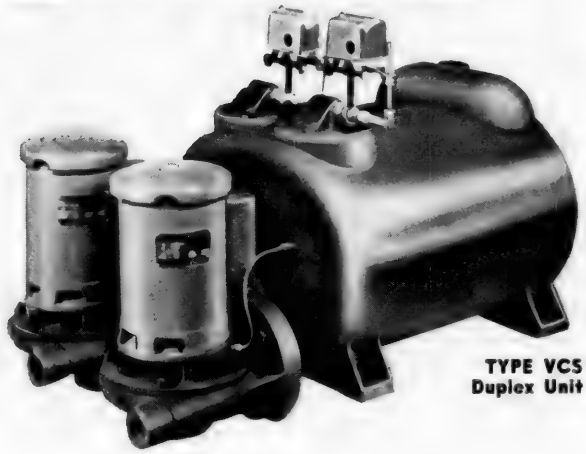
A new association, AMERICAN ASSOCIATION FOR CONTAMINATION CONTROL, has been formed to serve engineers in industry who are concerned with the control of contaminants. One of its first activities

(Continued on page 142)

IMPROVED DESIGN!



TYPE VCS
Single Unit



TYPE VCS
Duplex Unit

Mechanical Shaft-Seal

close-coupled design

TYPE CCVS
Single Unit

More Capacity!

More Performance!

TYPE HS
No. 14-B

New Bulletins

TYPE VCS—No. 10-C

TYPE CCVS—No. 21-C

Engineered to meet your exacting requirements. Select from a new wide range of types, sizes, capacities and pressures. Features include Low inlet connection—simplified construction, easily accessible for inspection — rugged cast iron receiver — bronze fitted throughout. Contact your local Skidmore representative or write direct for bulletins.

Skidmore pumps have set a standard of performance and dependability through continual development since 1921.

SKIDMORE CORPORATION ST. JOSEPH, MICHIGAN

Recent installation of Breidert ventilators on the Mt. Tahama School, Tacoma, Wash. Type BWR (power) in foreground; Types BWR and SG (gravity, with translucent top) in back. Robert Price, Architect... David M. Hopkins, Consulting Engineer.

AIR-X-HAUSTERS

BREIDERT POWAIR-X-HAUSTERS

In every section of the country, more and more architects and engineers are specifying BREIDERT AIR-X-HAUSTERS and POWAIR-X-HAUSTERS for all types of ventilating jobs. As the photo shows, BREIDERT ventilators are outstanding, with attractive low contours and square or rectangular shapes that conform handsomely to modern architectural design—an important reason for architects' growing preference for BREIDERTS.

Engineers have learned that BREIDERT ventilators, whether power or gravity, do the jobs they're rated for—unfailingly. BREIDERT capacities are certified, giving you full assurance of performance. BREIDERT ventilators are so nearly trouble-free that some engineers call a BREIDERT installation "preventive maintenance."

SAFE, SURE VENTILATION FOR EVERY PROBLEM

BREIDERT AIR-X-HAUSTERS (gravity) deliver positive, safe ventilation no matter which way the wind blows, barring interior negative pressures. BREIDERTS are unconditionally guaranteed to deliver their rated capacities when properly installed.

The complete line of power and gravity BREIDERTS, including round, square and rectangular models, is shown and described in a handsome 52-page Engineering Data Book which belongs in your files. We'll be glad to send you one. *On your next ventilating job, investigate* BREIDERTS *thoroughly*... there's a BREIDERT agent in or near your city. Consult your phone directory, your BREIDERT catalog, or write us. Member A. M. C. A.

THE G. C. BREIDERT CO.
13690 VAUGHN STREET, PACOIMA, CALIFORNIA
MAIL ADDRESS: P.O. BOX 1190, SAN FERNANDO

Briefly Stated

(Continued from page 140)

will be to meet with the people most knowledgeable about contamination control and to set up a program for standardizing such things as ways and means of taking dust counts. Membership is open to any person having a professional interest in the design, operation, supervision, or supply of equipment for contamination control areas. . . .

The name of the AMERICAN SOCIETY FOR TESTING MATERIALS was officially changed to the AMERICAN SOCIETY FOR TESTING and MATERIALS. The inclusion of the word *and* in the Society's name places added emphasis on its research work in seeking knowledge of the nature of materials. . . .

ENGINEERS INCORPORATED has moved into enlarged quarters at 20 Mt. Pleasant Avenue, Newark, N.J. The new offices will give the design and engineering firm additional space for its expanded operations and will allow for future expansions. The old offices were at 487 Orange Street, Newark. . . .

Dr. Henry R. Linden, research director of the INSTITUTE OF GAS TECHNOLOGY, has been appointed director of the institute—an education and research facility for the utility gas industry. He succeeds Dr. Martin A. Elliott, who has been named academic vice-president of Illinois Institute of Technology, with which IGT is affiliated. Mr. Elliott will continue to serve the gas industry as executive consultant to IGT. . . .

F. W. Muller, vice-president of Gustin-Bacon Mfg. Co., was elected president of the NATIONAL INSULATION MANUFACTURES ASSOCIATION, succeeding Emil T. Johnson, vice-president of Union Asbestos & Rubber Co. M. W. Burleson, vice-president of Johns-Manville Sales

(Continued on page 144)

This mark tells you a product is made of modern, dependable Steel.

Be sure the pipe you buy is marked "USS National Pipe... Made in U.S.A."

Take a good look at the next pipe you buy. Do you know who made it? How it was made? Its quality? If your pipe is marked "USS National Pipe—Made in U.S.A.," you can be sure you're getting high-quality steel pipe made on the most modern facilities by the largest pipe producer in the world. (National Tube led the way with its pipe-marking program.)

Order USS National Pipe from your local National Tube Distributor. You get fast delivery of the finest product from a man you can trust—a tough combination to beat!

USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division,
San Francisco Pacific Coast Distributors

TYPE G
CLOSE-COUPLED
CENTRIFUGAL

CUT PUMP COSTS

USE AURORA CENTRI-PAC PUMPS

CAPACITIES TO 400 GPM / HEADS TO 150 FEET

AVAILABLE IN A VARIETY OF PACKAGED SIZES

AIR CONDITIONING EQUIPMENT / CIRCULATING SERVICES / GENERAL SERVICES

- LOWER IN COST . . . made possible by standardization of most popular sizes packaged and stocked for immediate off-the-shelf shipment.
- EXTREMELY COMPACT . . . close-coupled design saves valuable space and is more easily installed.
- HIGHLY EFFICIENT . . . low horsepower requirement means less initial cost and lower operating expense.
- EASILY MAINTAINED . . . pump can be completely disassembled for inspection and repair without disturbing the piping.
- QUALITY CONSTRUCTION . . . bronze fitted, mechanical seals, drip-proof NEMA rated motor with stainless steel shaft and built-in overload protection, and cast bronze impeller keyed and locked in position.
- SMOOTH, QUIET OPERATION . . . low NPSH meets critical suction conditions.

You may also select from a complete line of horizontal or vertical mounted pumps and flexible-coupled pedestal-mounted pumps engineered to your specific requirements.

WRITE FOR BULLETIN 117 PKG

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
690 LOUCKS • AURORA, ILLINOIS
LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

Briefly Stated

(Continued from page 142)

Corp., was re-elected vice-president. Thomas J. Walters, manager of the Industrial Insulation Division of Ruberoid Co., is the new treasurer. NIMA members are manufacturers of inorganic thermal insulations covering the full temperature range.

BURGEONING BUSINESS

THE TRANE CO. recently opened a Rockford, Ill., sales office at 3623 East Street. The office will cover Winnebago and Stephenson counties in Illinois, and Rock and Green counties in Wisconsin. Edmund Volker is sales engineer assigned to the new office, which is under the over-all management of S. T. Shimanski of the Trane Madison, Wis., sales office. . . .

A new company, RICHARDS INDUSTRIES, INC., has acquired Dover Corporation's OPW-Jordan Division, manufacturers of regulator and control valves. Richards Industries, Inc., is headed by Gilbert B. Richards, Jr., formerly president of OPW-Jordan Division of Dover. Operations will be carried on as in the past, under the name of JORDAN VALVE DIVISION OF RICHARDS INDUSTRIES, INC. The same personnel and sales representatives will continue with the company. The specialty valve products of the OPW Division of Dover, heretofore distributed industrially by OPW-Jordan, will now be distributed by OPW, utilizing Jordan's same group of sales representatives.

CARRIER AIR CONDITIONING COMPANY will launch its 1961-62 series of training courses for dealers and distributors with a three-week session on packaged equipment sales engineering, starting November 27 in Syracuse, N. Y. A second class will run from January 22 to February 9, 1962.

A six-week course in application engineering for applied equipment dealers and distributors will begin January 8, and a two-week course

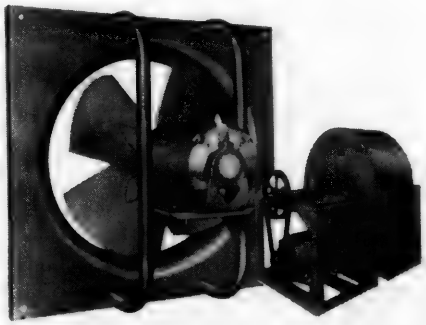
(Continued on page 146)

Talk About Fans!

Okay, let's talk about fans . . . Peerless Electric Fans in particular. Breeze or hurricane . . . you name it, and there's a Peerless Electric Fan to produce it. All-welded construction keeps scroll, housing and inlet firm and quiet. Air passes through at peak efficiency. All-welded wheels are statically and dynamically balanced for perfect rotation. Peerless Electric Fans can be specified with confidence, installed with ease, and operate inconspicuously and dependably for years.

Investigate Peerless Air Moving Equipment Today! Write to Peerless Electric Division, H. K. Porter Company, Inc., 1400 West Market St., Warren, Ohio.

Manufactured and sold in the western states by Master Fan Corporation, H. K. Porter Company, Inc., 1323 Channing Street, Los Angeles 21, California. NOW AVAILABLE—Centrifugal Blowers to 132" wheel diameter, Turbo Blowers to 55" S. P., Tube and Vaneaxial Blowers and Industrial Fans to 104" wheel diameter.



PORTER **PEERLESS ELECTRIC DIVISION**
H. K. PORTER COMPANY, INC.

Member—Air Moving and Conditioning Association, Inc.

Be Wise . . . Use
KENCO®
The First and Finest Submersible
PUMPS
with these exclusive pump values

Patented
VAC-TROL
Only KENCO has this new manual/automatic control

COMPLETE LINE
- For every sump pump need
- 600 to 8600 GPH
- 12 Models
- 115-v./230-v. single phase
- 230-v. 3-phase industrial
- Variable turn on up to 18 ft.

SINGLE WARRANTY

All parts guaranteed by KENCO—no "double" warranties.

NATIONWIDE

Chain of Service Centers —factory trained and supervised.

EASIEST to install
- No floats to adjust
- No rods to foul up
- No water level worries

Just plug it in any 115-v. outlet, connect discharge pipe and it's ready to go.
A-1215A

See Your Full Service Wholesaler

KENCO PUMP
Division of The American Electric Products Co.
12[illegible] Quentin Avenue • Lorain, Ohio

Briefly Stated

(Continued from page 144)

on small applied systems for packaged equipment dealers will start March 26.

Applications should be made through the distributors and will be accepted in Syracuse on the first come, first served basis.

NEW REPRESENTATIVES

Al Kaufmann, head of AIR FILTER SALES & SERVICE, Portland, Oregon, has been appointed sales representative for ILG ELECTRIC VENTILATING CO., Chicago. Mr. Kaufmann has operated in the Portland area for the past eight years. . . .

WILLIAM W. MEYER & SONS, INC., Skokie, Ill., appointed Sam D. Mullin as territorial sales supervisor. The company is the Chicago area representative for GENERAL BLOWER CO., Morton Grove, Ill., manufacturer of industrial air and material handling equipment. Mr. Mullins was recently agent-sales manager of General Blower Co. Prior to that, he was senior sales engineer with Bishop & Babcock Mfg. Co.

PERSONNEL CHANGES

MINNEAPOLIS-HONEYWELL has appointed two new managers in its Commercial Division. Richard J. Looney, appointed manager of air cleaner sales, will direct sales of all electronic air cleaners and activated charcoal filters. For the past four years, he has been in management positions on electronic temperature controls and air cleaners. He replaces William Wray, who will concentrate on building automation. William J. Ortman, named building market manager, has had 17 years of experience in industrial and office automation, and will continue as manager of industrial and marine markets for Honeywell. He replaces William W. T. Gove, named manager of markets. . . .

Anthony Amoroso was named Southern Calif. district sales manager for BRADLEY WASHFOUNTAIN CO., manufacturer of group washing and showering equipment. One of Mr. Amoroso's major responsibilities will be working with architects in the Southern Calif. area. He had been architect-engineer representative for American-Standard for six years. He is active in the Southern California Producers' Council, currently serving as membership chairman. . . .

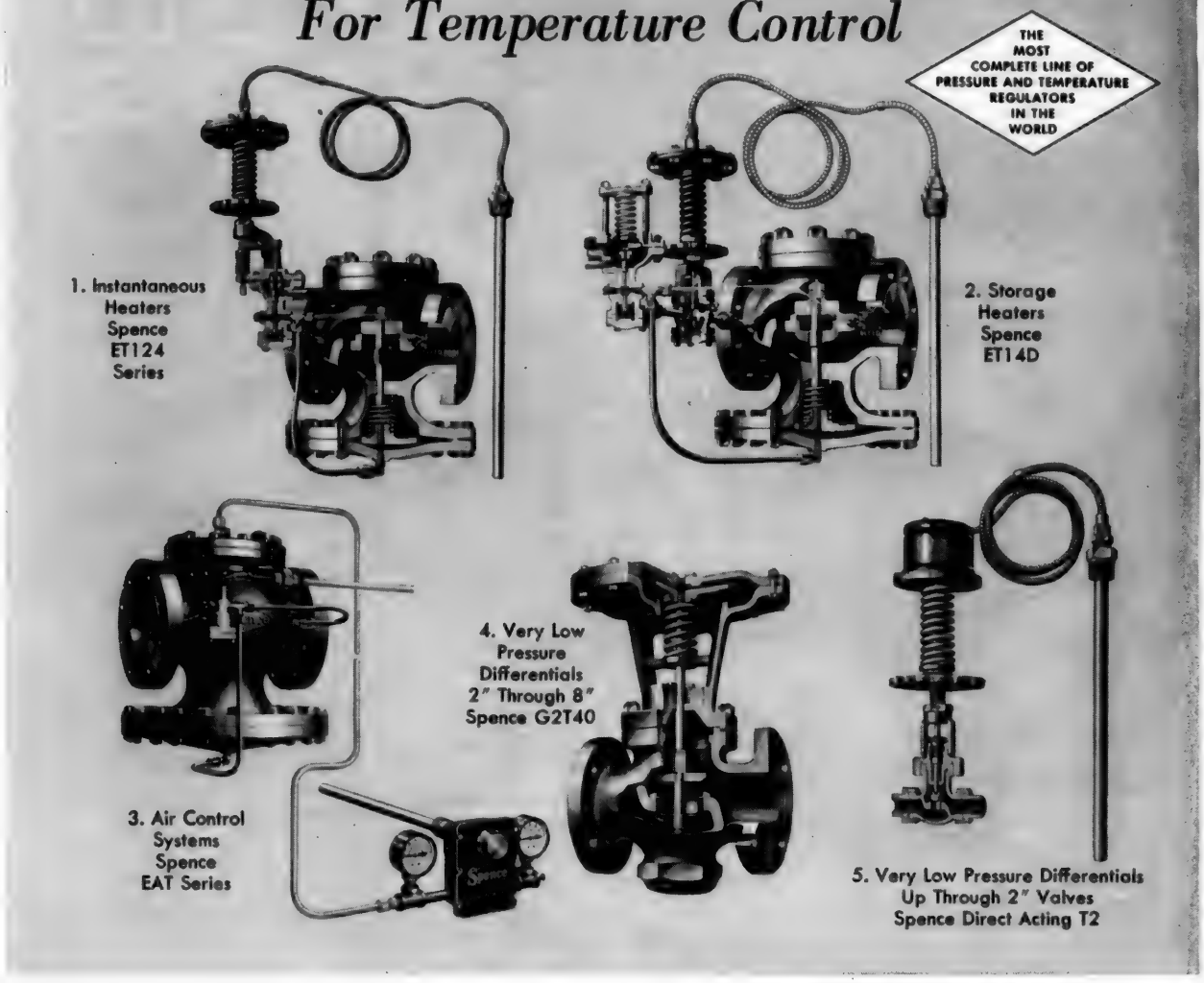
BELL & GOSSET CO., announced four appointments in its Hydro-Flo Division. Herbert Miesfeldt, named sales coordinator, will be responsible for administrative matters relating to products, pricing and order handling. James Jordan has been appointed field sales manager in the Centrifugal Pump Dept. Other appointments include James Rippel to assistant products manager, Hydronic Accessories Dept., and Robert Anderson to the same post in the Centrifugal Pump Department. . . .

Dante C. Fabiani has been elected president of CRANE CO. Mr. Fabiani joined Crane as executive vice-president last year and was elected a director in April of this year. Before coming to Crane, Mr. Fabiani was financial vice-president and a director of McDonnell Aircraft Corp., and prior to that was a vice-president of H. K. Porter Co., Inc. . . .

L. Churchill Austin has been appointed sales manager of the refrigeration and wholesale air conditioning division of MCQUAY, INC., Prior to joining McQuay, Mr. Austin was sales manager, advertising director and secretary of Norris Dispensers, Inc., who are manufacturers of milk dispensing equipment. . . .

(Continued on page 148)

How to Select Automatic Regulating Valves For Temperature Control


THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD
1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated pilot operated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".
5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. 88-180

SPENCE ENGINEERING COMPANY, INC.
Walden 1, N. Y.
Paulsen Spence, P. E., President

New!

SERIES 500

ELGIN

WATER SOFTENER

Elgin Quality at Amazingly Low Price!

Here is your final answer for those commercial jobs where water softener dependability is a must, but price is often a deciding factor.

In the new Elgin 500 series you have a fully automatic water softener that truly offers that traditional Elgin quality at an amazingly low price—a value that only Elgin's 50 years of experience could make a reality.

It is the kind of product that you can stand squarely behind—a product designed and built down to the last detail to do its job day after day with an absolute minimum of servicing. Above all it is:

EASY TO SIZE
EASY TO INSTALL

Series 500 softeners are also available in manually operated models. At their still lower price, they register a new high value in the manual type of softener.

Get the complete story
Write for bulletin

ELGIN SOFTENER CORPORATION
153 N. Grove Ave., Elgin, Illinois
Representatives in Principal Cities
In Canada: G. F. Sterne & Sons, Ltd., Brantford

Briefly Stated

(Continued from page 146)

ATMOS-PAK INC., Ossining, N. Y., has appointed Kennon G. Hull national sales manager. Mr. Hull was formerly eastern regional manager for Janitrol Heating and Air Conditioning, Div. of Midland-Ross Corp. Preparatory to a stepped-up sales drive which will begin this fall, Mr. Hull is organizing territories, contacting representatives, and developing sales data. . . .

Dr. Ralph P. Hudson has been appointed chief of the Heat Division at the NATIONAL BUREAU OF STANDARDS, U. S. Department of Commerce. He succeeds Dr. Charles M. Herzfeld, recently appointed associate director of NBS. Dr. Hudson will be responsible for the Bureau's program of maintaining temperature scales, standards of heat capacity, and heat of combustion, and for supporting research in various fields of atomic and molecular physics. This work fulfills one of the Bureau's primary functions in providing science and industry with a fundamental basis for precise measurements of heat.

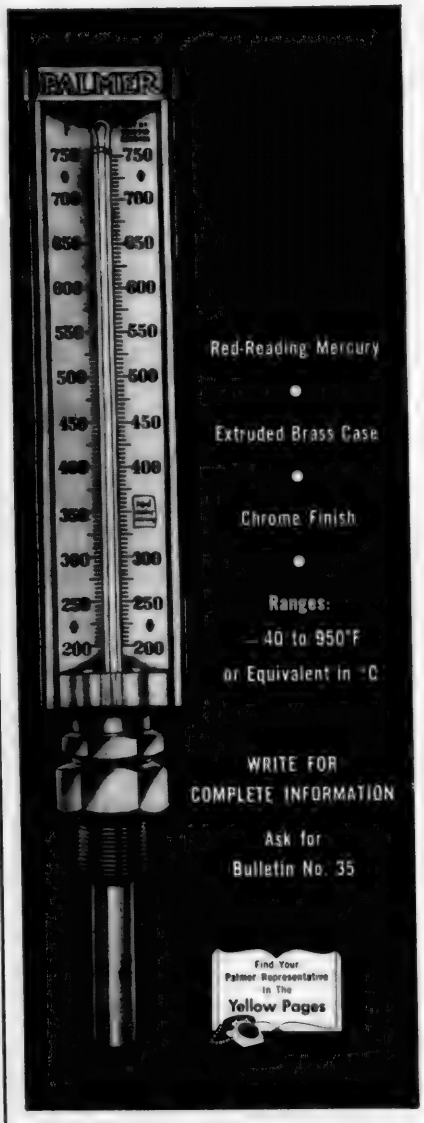
Four new staff appointments were made by the AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE). They are: Andrew T. Boggs III — associate secretary; Martin A. Mayers—manager of research; Herbert P. Tinning—technical secretary; and Robert J, Anthony — senior associate editor, ASHRAE *Journal*. Formerly technical secretary of the Society, Mr. Boggs has been elevated to the position of associate secretary to assist the executive secretary in his various duties. The new manager of research, Mr. Mayers, will direct the Society's extensive research program of grants-in-aid to colleges and private laboratories and will coordinate the activities of the technical committees for maximum effectiveness to the Society. The

(Concluded on page 150)

TODAY'S MODERN INDUSTRY
DEMANDS A MODERN THERMOMETER

PALMER

RED-READING MERCURY THERMOMETERS



PALMER

PALMER THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers • Cincinnati 12, Ohio

Ross Gear and Tool Co., Lebanon, Tenn. **Architects and Engineers:** Spencer J. Warwick & Associates. **General Contractor:** Anderson and Gore. **Mechanical Contractor:** Central Air Conditioning & Heating, Inc.

680 tons of Chrysler Air Conditioning on the roof save 1100 sq. ft. of valuable floor space inside

Sprouting from the roof of this new plant for Ross Gear and Tool Company are 22 Chrysler 30-ton packaged air conditioning units. Together with two Chrysler packaged liquid chillers and four split-system units, they provide the cooling (785 tons of it!) for almost five acres of manufacturing and office space.

By putting 680 tons of Chrysler Air Conditioning *on* the roof, instead of *under* it, the company freed 1100 sq. ft. of valuable floor space for other jobs. And by installing these units zone-by-zone during construction, the company saved money by starting operations in part of the building while the rest was being completed.

The cooling load is spread over 28 different Chrysler units, ranging from a 4-ton condensing unit to a 45-ton chiller. Thus, varying departmental load requirements can be handled with ease. There is no fixed operating cost, as there would be with a conventional single-unit installation.

Whether your job calls for air-cooled or water-cooled equipment . . . packaged units or chillers . . . you'll find the complete Chrysler line has the exact unit you need. For complete data, or the technical cooperation of a Chrysler Engineer, write today.

CHRYSLER
AIRTEMP
A Division of Chrysler Corporation
Dept. D-111, Dayton 4, Ohio

(Concluded from page 148)

new technical secretary, Mr. Tinning, will actively coordinate staff work upon national meetings programs with the Program Committee and will provide liaison with the Standards Committee. Mr. Anthony, in addition to assisting the editor and working with others on the editorial staff, will be active not only on the *Journal*, but also on *Transactions*, preprints as well as bulletins. . . .

Joseph J. Merrick was appointed vice president in charge of sales for NORMAN PRODUCTS DIV., JOHN J. NESBITT, INC., Philadelphia. Mr. Merrick joined Nesbitt in 1935 as a draftsman, and rose in the company to divisional manager for heating and air conditioning products in the commercial, industrial and residential markets. He has served as a member of the board of directors and secretary-treasurer of the Air Moving and Conditioning Association. Previously, he had been president of the Industrial Unit Heater Association. In addition, he has been active in many committees of both the IUHA and the AMCA as well as company representative to the American Gas Association, the Better Heating and Cooling Council and the Institute of Boiler and Radiator Manufacturers. . . .

Edward S. Bunn has been elected vice president of REVERE COPPER AND BRASS INC., in charge of research and development. He succeeds Richard A. Wilkins who is retiring. Mr. Bunn joined Revere in 1932 as a research metallurgist. He advanced in the company and, in 1960, was named general manager of the research and development department. . . .

ARNO ADHESIVE TAPES, INC., Michigan City, Ind., has made two executive appointments. Robert P. Bolles was named merchandising manager for the firm. He has been with the company for four years and was formerly products manager. Theodore R. Woodfield, formerly project engineer, was named assistant director of research. He has been with the company for three years. . . .

HYDROTHERM, INC., Northvale, N.J., has appointed Charles E. O'Brien to represent the company in all of Long Island and Brooklyn. Mr. O'Brien was with Minneapolis Honeywell prior to joining the Hydrotherm sales staff. . . .

THE TRANE CO., La Crosse, Wis., appointed William J. Tarnowski a sales engineer in charge of the new Springfield, Mass. sales office at 1200 Main Street. The office will serve Springfield, Franklin, Hampshire and Hampden counties in Massachusetts. Andrew K. Morris, who joined Trane in 1950 as a sales engineer, was promoted to manager of the Kansas City sales office. . . .

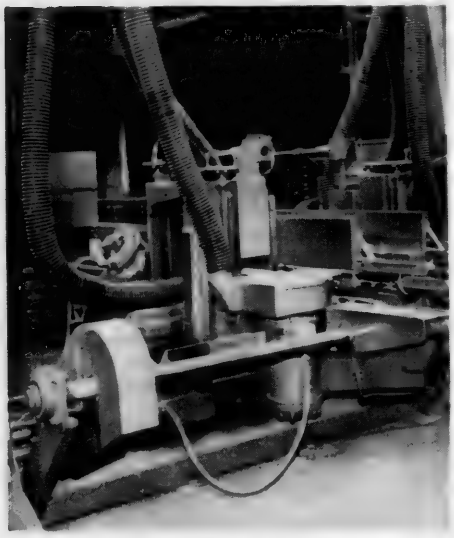
William L. Arbuckle, named Eastern sales manager for the Commercial Div., JENN-AIR PRODUCTS CO., INC., Indianapolis, has had nine years' experience in the heating, ventilating and air conditioning business. In his new position he will cover all Atlantic coastal states from Maine to Florida. Jenn-Air's Eastern regional office will be in Charlotte, N. C.

Robert J. Kenny has been appointed chief design engineer of the Air Impeller Division of THE TORRINGTON MANUFACTURING COMPANY, Torrington, Conn. He will supervise design of all the Division's air-moving products, including air impellers, commercial blower units and specialty blowers.

FLEXAUST®
HOSE

Dust Collection
for Fume Control
Materials Handling

MAKES GOOD INSTALLATIONS BETTER



Thousands of successful installations prove that use of Flexaust hose and Portovent retractable duct with metal duct systems lower installation costs — but there are other important advantages.

Exceptional abrasion resistance
Corrosion resistance
Noise absorption
Durability under heavy flexing
Provision for expansion and contraction
Easy relocation of hoods and machines

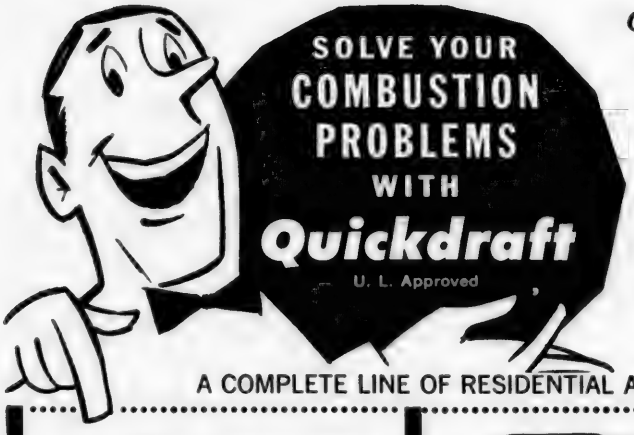
Made of high quality neoprene coated fabrics 1¼ to 36" i.d.

Write today for full details

Distributors in all principal cities

THE FLEXAUST CO.

DEPT. HV-11 100 PARK AVE.
NEW YORK 17, N. Y.



CHECK THESE FEATURES

- ✓ Stops pulsating and chattering
- ✓ Increases heating efficiency and ouptut
- ✓ One unit handles furnace or boiler, incinerator and hot water heater on single chimney
- ✓ Keeps furnaces, boilers and chimneys free of soot
- ✓ Stops blow-back of poisonous fumes
- ✓ Ideal for homes with outside chimneys
- ✓ Fireplace units with special fittings for direct installation into chimneys with single or two-speed motors available

Will operate with temperatures up to 1700 degrees

A COMPLETE LINE OF RESIDENTIAL AND LIGHT CONSTRUCTION MODELS

SIZES AVAILABLE
4 INCH
5 INCH
6 INCH
7 INCH

SIZES AVAILABLE
8 INCH
9 INCH
10 INCH

12 INCH

Patents
U. S. 2,722,872 and 2,855,874
British 802,920
Canadian 583,817
Other patents pending

10175-QD

WRITE FOR NEW LOW PRICES ON ALL THESE MODELS

HEAVY-DUTY INDUSTRIAL UNITS AVAILABLE
12" 14" 16" 18" 20" 22" 24" 30"
Larger sizes can be made to order

For corrosive service all Quickdraft units are available in standard acid-resisting vitreous enamel, 316 stainless steel, rigid plastics (P.V.C) and with plastic or Fiberglas coatings.

Quickdraft CORPORATION

Box 1353-O, Sta. C
Canton, S.W., Ohio

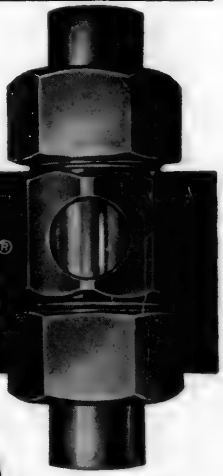
NEW! Waterproof!

NOW STANDARD ON ALL REGULARLY CATALOGUED JE SOLENOID VALVES

New epoxy-clad coils are line-tested at 2300 volts completely submerged in water. Eliminate coil failure! Impervious to almost anything and everything—condensation, fluid spray, frost, oil, gasoline and other corrosive liquids and vapors. Unlimited indoor or outdoor applications. U.L. listed. Wire, write, or phone:

CONTROLS DIVISION **JACKES EVANS MFG. CO.**
4427 GERALDINE AVENUE • ST. LOUIS 15, MO.

PROVED ON THOUSANDS OF PRODUCTION LINE INSTALLATIONS!



"250" SERIES
LIQUID EYE®
POSITIVE SEALING INDICATORS
designed to save you even more time and money

DESIGN FEATURE

extension-gasket . . . ALL ONE-PIECE!
A built-in gasket that's always in place for positive sealing and foolproof assembly.

6 sizes now available: ⅜", ½", ⅝", ⅞", 1⅛" and 1⅜" O.D.S.

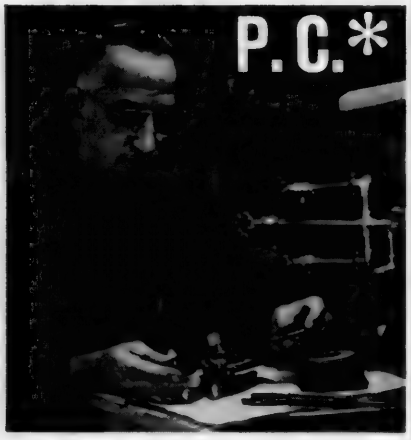
The "250" has all the proved Liquid Eye advantages *plus* these newly engineered features:

- **smaller—more compact, simplified design.**
- **preformed copper extension eliminates need for separate gaskets—*foolproof* installation.**
- **complete, self-contained, economy unit.**

Write today for catalog E-57 covering the complete Allin line.

Allin
ALLIN MANUFACTURING CO.
410 N. Hermitage Ave. • Chicago 22, Illinois
Over 1,000,000 Liquid Eyes Sold to Date!

air-conditioning service calls are minimized when you use



*preventive-care

Service calls, even on a contract basis, can be made to pay off if they are held to a minimum through "preventive-care" . . . care that minimizes the possibility of automatic controls damaged from the corrosive or gumming action of oil, water vapor and other contaminants in the compressed air lines.

HANKISON Series E AIR DRYERS

. . . are practical "preventive-care" units. Economically and easily installed in new or existing air-conditioning systems. Series E Air Dryers precipitate contaminants from compressed air lines before these contaminants can attack the delicate mechanisms of automatic controls and render them inoperative. Plan now to include "preventive-care" on the next air-conditioning system you service—recommend Hankison Series E Air Dryers.

For complete information, write today for Bulletin 9300

PREFERRED for practical air drying

Hankison CORPORATION

College and Pike Canonsburg, Pa.

(Greater Pittsburgh Area)

UNITED STATES DEGREE

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 33rd Year of Publication of Monthly Degree-Day Data

City	September			Season to Sept. 30 from Sept. 1		
	1961	1960	Normal	1961	1960	Normal
Abilene, Texas (A)	20	3	5	20	3	5
Albany, New York (A)	79	100	139	79	100	139
Albuquerque, New Mexico (A)	43	3	10	43	3	10
Alpena, Michigan (C)	172	289	215	172	289	215
Anchorage, Alaska (A)	489	530	510	1028†	1052†	1040†
Asheville, North Carolina (C)	49	32	50	49	32	50
Atlanta, Georgia (A)	12	5	8	12	5	8
Atlantic City, New Jersey (C)	10	16	29	10	16	29
Augusta, Georgia (A)	6	0	0	6	0	0
Baltimore, Maryland (C)	12	4	29	12	4	29
Billings, Montana (A)	379	150	194	379	150	194
Binghamton, New York (C)	117	64	141	117	64	141
Birmingham, Alabama (A)	3	0	13	3	0	13
Bismarck, North Dakota (A)	385	228	227	385	228	227
Block Island, Rhode Island (A)	39	79	88	39	79	88
Boise, Idaho (A)	239	63	135	239	63	135
Boston, Massachusetts (A)	51	103	77	51	103	77
Buffalo, New York (A)	76	77	122	76	77	122
Burlington, Iowa (A)	125	45	83	125	45	83
Burlington, Vermont (A)	104	195	172	104	195	172
Cairo, Illinois (C)	16	0	28	16	0	28
Charleston, South Carolina (C)	3	0	0	3	0	0
Charlotte, North Carolina (A)	8	4	7	8	4	7
Chattanooga, Tennessee (A)	9	6	24	9	6	24
Cheyenne, Wyoming (A)	405	176	241	405	176	241
Chicago, Illinois (A)	77	26	90	77	26	90
Cincinnati, Ohio (C)	22	4	42	22	4	42
Cleveland, Ohio (A)	74	67	75	74	67	75
Columbia, Missouri (A)	80	11	62	80	11	62
Columbia, South Carolina (A)	7	0	0	7	0	0
Columbus, Ohio (C)	43	26	59	43	26	59
Concord, New Hampshire (A)	86	180	192	86	180	192
Concordia, Kansas (C)	145	28	55	145	28	55
Dallas, Texas (A)	1	0	0	1	0	0
Denver, Colorado (A)	273	90	120	273	90	120
Des Moines, Iowa (A)	167	82	99	167	82	99
Detroit, Michigan (A)	64	53	96	64	53	96
Devils Lake, North Dakota (C)	378	230	276	378	230	276
Dodge City, Kansas (A)	126	34	40	126	34	40
Dubuque, Iowa (A)	174	112	149	174	112	149
Duluth, Minnesota (A)	343	299	277	343	299	277
El Paso, Texas (A)	0	0	0	0	0	0
Ely, Nevada (A)	368	137	228	368	137	228
Escanaba, Michigan (C)	208	219	247	208	219	247
Evansville, Indiana (A)	44	6	59	44	6	59
Fairbanks, Alaska (A)	622	701	612	1095†	1124†	1057†
Fargo, North Dakota (A)	301	223	215	301	223	215
Fort Smith, Arkansas (A)	14	0	9	14	0	9
Fort Wayne, Indiana (A)	79	51	107	79	51	107
Fort Worth, Texas (A)	0	0	0	0	0	0
Fresno, California (A)	0	0	0	0	0	0
Galveston, Texas (C)	0	0	0	0	0	0
Grand Junction, Colorado (A)	195	17	36	195	17	36
Grand Rapids, Michigan (A)	89	90	144	89	90	144
Green Bay, Wisconsin (A)	182	197	183	182	197	183
Greensboro, North Carolina (A)	23	21	29	23	21	29
Greenville, South Carolina (A)	9	3	10	9	3	10
Harrisburg, Pennsylvania (A)	41	23	69	41	23	69
Hartford, Connecticut (A)	63	117	101	63	117	101
Havre, Montana (A)	432	208*	270*	432	208*	270*
Helena, Montana (A)	476	242	320	476	242	320
Hicksville, L. I., N. Y.	23	24	(a)	23	24	(a)
Houston, Texas (C)	0	0	0	0	0	0
Huron, South Dakota (A)	276	220	149	276	220	149
Indianapolis, Indiana (A)	60	28	79	60	28	79
Jackson, Mississippi (A)	5	0	0	5	0	0
Juneau, Alaska (A)	511	466	480	1112†	1142†	1134†
Kansas City, Missouri (A)	100	12	44	100	12	44
Knoxville, Tennessee (A)	15	3	33	15	3	33
La Crosse, Wisconsin (A)	188	148	152	188	148	152
Lander, Wyoming (A)	426	164	244	426	164	244
Lewiston, Maine (O)	96	192	165	96	192	165
Lincoln, Nebraska (C)	183	55	79	183	55	79
Little Rock, Arkansas (A)	10	0	10	10	0	10
Los Angeles, California (C)	2	0	17	2	0	17
Louisville, Kentucky (A)	30	10	51	30	10	51

-DAYS FOR SEPT., 1961

City	September			Season to Sept. 30 from Sept. 1		
	1961	1960	Normal	1961	1960	Normal
Lynchburg, Virginia (A)	37	29	49	37	29	49
Macon, Georgia (A)	3	0	0	3	0	0
Madison, Wisconsin (A)	188	134	137	188	134	137
Marquette, Michigan (C)	224	243	236	224	243	236
Memphis, Tennessee (A)	8	0	17	8	0	17
Meridian, Mississippi (A)	7	0	0	7	0	0
Milwaukee, Wisconsin (A)	134	142	134	134	142	134
Minneapolis, Minnesota (A)	239	202	157	239	202	157
Moline, Illinois (A)	121	(a)	96	121	(a)	96
Montgomery, Alabama (A)	2	0	0	2	0	0
Nashville, Tennessee (A)	23	0	22	23	0	22
New Haven, Connecticut (A)	41	103	93	41	103	93
New Orleans, Louisiana (C)	0	0	0	0	0	0
New York, N. Y. Central Park (C)	20	10	31	20	10	31
New York International	28	16	(a)	28	16	(a)
New York LaGuardia	22	11	28	22	11	28
Newark, New Jersey (A)	21	14	47	21	14	47
Norfolk, Virginia (A)	7	0	9	7	0	9
North Platte, Nebraska (A)	278	124	120	278	124	120
Oak Ridge, Tennessee (C)	22	4	(a)	22	4	(a)
Oakland, California (A)	39	75	76	39	75	76
Oklahoma City, Oklahoma (A)	40	2	12	40	2	12
Omaha, Nebraska (A)	174	63	88	174	63	88
Parkersburg, West Virginia (C)	50	14	56	50	14	56
Peoria, Illinois (A)	120	53	86	120	53	86
Philadelphia, Pennsylvania (C)	14	2	33	14	2	33
Phoenix, Arizona (A)	0	0	0	0	0	0
Pittsburgh, Pennsylvania (C)	45	18	56	45	18	56
Pittsfield, Massachusetts (A)	100	190	213	100	190	213
Portland, Maine (A)	104	211	199	104	211	199
Portland, Oregon (C)	112	83	85	112	83	85
Providence, Rhode Island (A)	49	117	107	49	117	107
Pueblo, Colorado (A)	184	41	74	184	41	74
Raleigh, North Carolina (A)	19	11	10	19	11	10
Rapid City, South Dakota (A)	327	154	193	327	154	193
Reading, Pennsylvania (C)	32	24	57	32	24	57
Red Bluff, California (A)	2	0	0	2	0	0
Reno, Nevada (A)	267	127	165	267	127	165
Richmond, Virginia (A)	27	24	33	27	24	33
Rochester, New York (A)	82	83	133	82	83	133
Roswell, New Mexico (A)	21	10	8	21	10	8
Sacramento, California (C)	7	3	17	7	3	17
St. Joseph, Missouri (A)	121	44	49	121	44	49
St. Louis, Missouri (C)	33	5	38	33	5	38
Salt Lake City, Utah (A)	207	16	88	207	16	88
San Antonio, Texas (A)	0	0	0	0	0	0
San Diego, California (A)	0	0	24	0	0	24
Sandusky, Ohio (C)	48	22	66	48	22	66
San Francisco, California (C)	90	169	110	90	169	110
Sault Ste. Marie, Michigan (A)	214	276	298	214	276	298
Savannah, Georgia (A)	3	0	0	3	0	0
Scranton, Pennsylvania (A)	80	92	115	80	92	115
Seattle, Washington (C)	134	146	134	134	146	134
Sheridan, Wyoming (A)	434	205	239	434	205	239
Shreveport, Louisiana (A)	1	0	0	1	0	0
Sioux City, Iowa (A)	189	96	128	189	96	128
Spokane, Washington (A)	268	153	205	268	153	205
Springfield, Illinois (A)	75	13	56	75	13	56
Springfield, Missouri (A)	69	13	61	69	13	61
Syracuse, New York (A)	70	83	117	70	83	117
Toledo, Ohio (A)	87	64	102	87	64	102
Topeka, Kansas (A)	116	31	42	116	31	42
Trenton, New Jersey (C)	34	31	55	34	31	55
Tulsa, Oklahoma (A)	37	0	18	37	0	18
Utica, New York (O)	13	55	182	13	55	182
Valentine, Nebraska (A)	301	179	145	301	179	145
Walla Walla, Washington (C)	119	41	93	119	41	93
Washington, D. C. (A)	16	7	32	16	7	32
Wichita, Kansas (A)	86	13	32	86	13	32
Williston, North Dakota (C)	396	209	261	396	209	261
Winnemucca, Nevada (A)	298	109	180	298	109	180
Yakima, Washington (A)	202	145	150	202	145	150

a) Data not available.

† Includes July and August.

• City office data.

Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with three exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, and Hicksville, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Co., Utica, N. Y., Norman E. Ross, Bursar, Bates College, Lewiston, Me., and Long Island Lighting Co., Mineola, N. Y., respectively.

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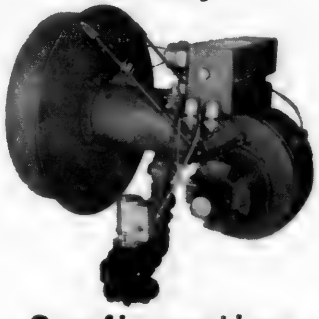

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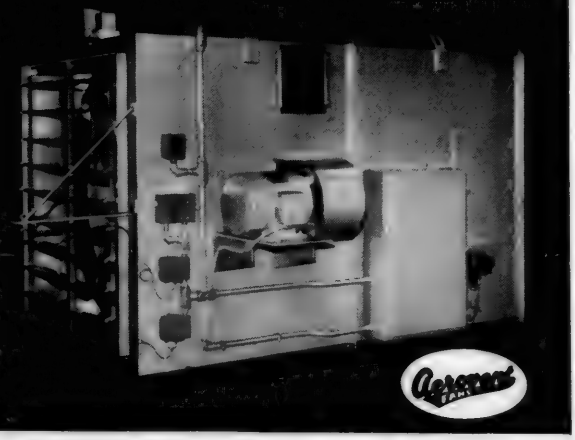

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

BRI FALL CONFERENCES—Building Research Institute Spring Conferences, Shoreham Hotel, Washington, D. C. BRI, 2101 Constitution Ave., Washington 25, D. C. .....**NOVEMBER 14-16, 1961.**

NEMA MEETING—The 35th annual meeting of the National Electrical Manufacturers Association will be held at The Plaza Hotel, New York City, N. Y. For information write Russell Gingles, Director of Public Relations, 155 East 44th Street, New York 17, N. Y. .....**NOVEMBER 16, 1961.**

PLUMBING BRASS MEETING—The annual meeting of Plumbing Brass Institute at the Savoy-Hilton Hotel, New York City, N. Y. For information write: Arthur L. Weldy, Shea Expositions Corp., One Gateway Center, Pittsburgh, Pa. . .**NOVEMBER 27-29, 1961.**

CORROSION ENGINEERS CONFERENCE—The regional conference of the National Association of Corrosion Engineers will meet this Fall. For information write T. J. Hull, Executive Secretary, 1061 M & M Building, Houston, Texas.
Southeast Region, Miami, Florida. .....**NOVEMBER 27-DECEMBER 1, 1961.**

CHEMICAL INDUSTRY EXPOSITION—The 28th Exposition of Chemical Industries will be held at the New York Coliseum, under the management of the International Exposition Co., 480 Lexington Ave., New York 17, N. Y. E. K. Stevens, manager. .....**NOVEMBER 27-DECEMBER 1, 1961.**

BHC COUNCIL MEETING—The sixth annual meeting of the national Better Heating-Cooling Council will be held at the Hotel Delmonico, New York City, N. Y. For information write Ray Schumack, 250 Park Ave., New York 17, N. Y. .....**DECEMBER 18-19, 1961.**

ENGINEERING & MAINTENANCE SHOW—National Plant Engineering & Maintenance Show, Convention Hall, Philadelphia. Clapp & Poliak, Inc., 341 Madison Avenue, New York 7, N. Y. .....**JANUARY 22-25, 1962.**

AUTOMOTIVE AIR CONDITIONING FORUM—8th Annual National Forum on automotive air conditioning sponsored by Automotive Air Conditioning Association, Inc., Statler-Hilton Hotel, Dallas, Texas. L. T. Merrill, Secretary-Treasurer, Automotive Air Conditioning Association, 4924 Greenville Avenue, Dallas 6, Texas. .....**JANUARY 25-26, 1962.**

ARI EXPOSITION—Air Conditioning and Refrigeration Institute 12th Exposition. Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, 1346 Connecticut Ave. N.W., Washington 6, D. C. .....**FEBRUARY 12-15, 1962.**

ELECTRIC HEATING SHOW—The Second National Electric House Heating Symposium and Exposition, sponsored by Electric House Heating Section, National Electrical Manufacturers Association. 155 East 44th Street, New York 17, N. Y., to be held at the Sherman Hotel, Chicago, Ill. Write Russell Gingles, NEMA director of public relations. .....**MARCH 19-21, 1962.**

OIL HEAT AND AIR CONDITIONING—24th Oil Heat and Air Conditioning Exposition sponsored by National Oil Fuel Institute, Conrad Hilton Exhibit Hall, Chicago. The 40th annual oil heat industry convention will run concurrently with the Exposition. Ralph T. Hartell, National Oil Fuel Institute, Inc., 60 East 42nd Street, New York 17, N. Y. .....**APRIL 9-12, 1962.**

WELDING CONVENTION AND EXPOSITION—43rd Annual Convention and Welding Exposition of the American Welding Society in Cleveland, Ohio. Technical meeting will be held in the Sheraton Cleveland Hotel and the Welding Show in the Cleveland Public Auditorium. Information Center, American Welding Society, 345 East 47th Street, New York 17, N. Y. .....**APRIL 9-13, 1962.**

Canadian Degree-Days for September, 1961*

City	September 1961	September Normal	Cumulative 1961	Cumulative Normal
Calgary, Alta.	557	410	557	410
Charlottetown, P.E.I.	135	240	135	240
Crescent Valley, B. C.	397	330	397	330
Edmonton, Alta.	518	440	518	440
Fort William, Ont.	356	370	356	370
Grande Prairie, Alta.	552	450	552	450
Halifax, N. S.	72	190	72	190
London, Ont.	106	150	106	150
Medicine Hat, Alta.	450	300	450	300
Moncton, N. B.	135	260	135	260
Montreal, P. Q.	100	190	100	190
North Bay, Ont.	215	320	215	320
Ottawa, Ont.	125	200	125	200
Penticton, B. C.	252	200	252	200
Prince George, B. C.	595	460	595	460
Quebec, P. Q.	187	290	187	290
Regina, Sask.	477	370	477	370
Saint John, N. B.	161	280	161	280
Saskatoon, Sask.	526	380	526	380
Timmins, Ont.	324	410	324	410
Toronto, Ont.	74	154	74	154
Vancouver, B. C.	246	220	246	220
Victoria, B. C.	251	230	251	230
Windsor, Ont.	83	120	83	120
Winnipeg, Man.	385	311	385	311

* These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

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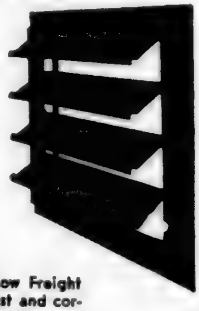

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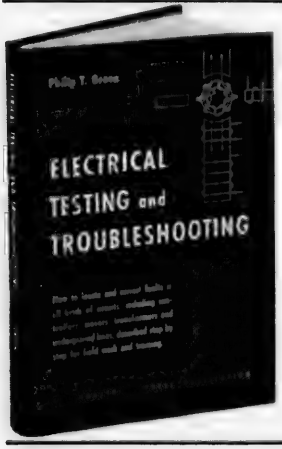

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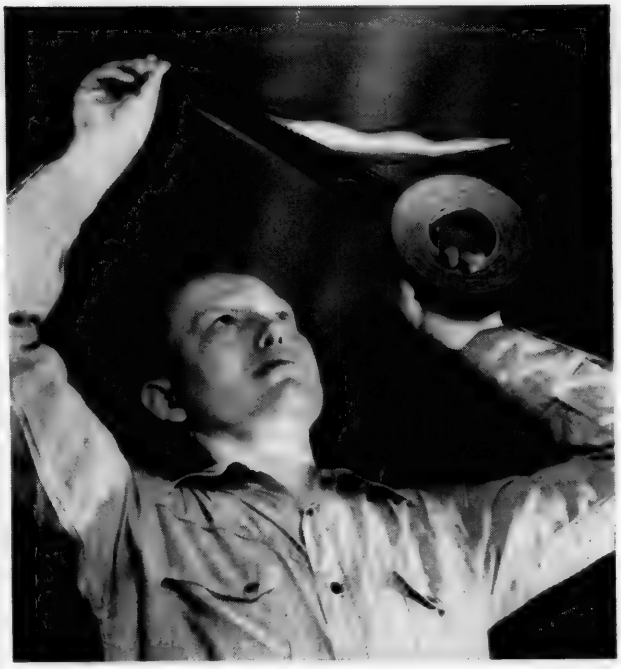

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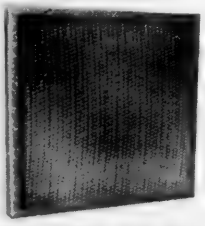

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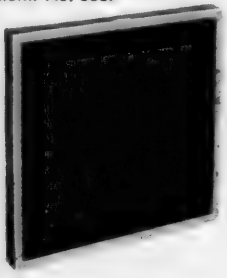

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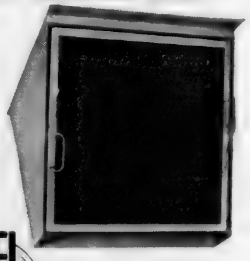

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CONTACT: Plastics Div., Allied Chemical Corp., 40 Rector St., New York 6, N.Y.

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TITLE: "The Constant Search."

THEME: 20-min 16mm sound-color film tells the story of the first use of a jet-powered gas turbine for stationary power in a natural gas compressor station at Possum Trot, Ky.

CONTACT: Public Relations Dept., The Columbia Gas System, Inc., 120 E. 41st St., New York 17, N.Y.

* * *

TITLE: "Pyrex Brand Double-Tough Drainline."
"How to Cut and Bead Pyrex Brand Pipe."

THEME: First film, 20-min 16mm sound and color, explains why this glass drainline is effective in the disposal of corrosive wastes and how it is installed. Second film, 16mm sound-color, demonstrates a cutting and beading operation. Ten minute running length is actual time required for this operation.

CONTACT: Advertising and Sales Promotion Dept., Corning Glass Works, Corning, N.Y.

* * *

TITLE: "Off the Floor Fixtures."

THEME: 28-min full-color sound slide film shows the developments in off the floor fixtures, the advantages, and methods of installation. A cartoon character named "Unitron" serves as guide through the film.

CONTACT: Josam Manufacturing Co., Michigan City, Ind.

* * *

TITLE: "Semi-Rigid Plastic Pipe."

THEME: 20-min 16mm color-sound film covers ABS semi-rigid plastic pipe. Urban and rural water systems, gas utilities, and manufacturers of mobile homes are gaining superior piping performance while cutting purchase and installation costs.

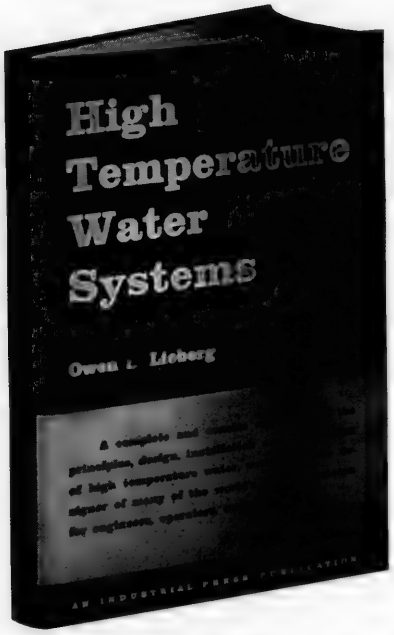
CONTACT: Film Dept. C-2, Marbon Chemical Div., Borg-Warner Corp., Washington, W. Va.

* * *

TITLE: "Fishing Fantastico."

THEME: 27-min 16mm color and sound film chronicles the six week fishing odyssey of Ben Hardesty, champion angler and accuracy caster, through Chile and Argentina. Film is reported to contain some of the most spectacular natural scenery ever recorded on film.

CONTACT: General Motors Corp., Public Relations Staff—Film Library, General Motors Building, Detroit 2, Mich.



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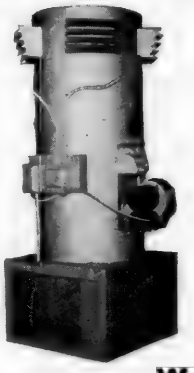

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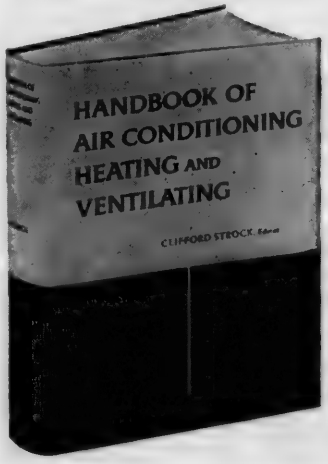

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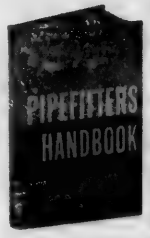

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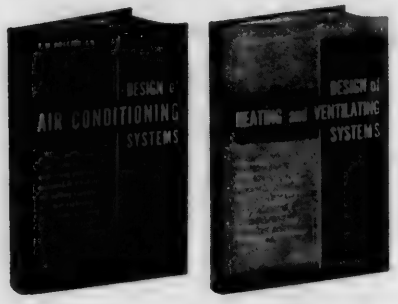

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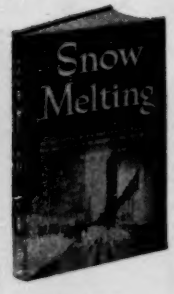

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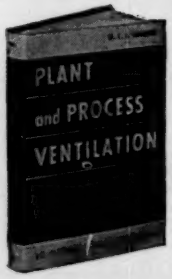

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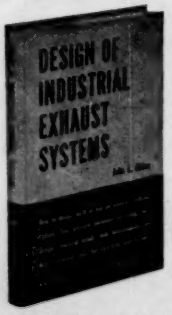

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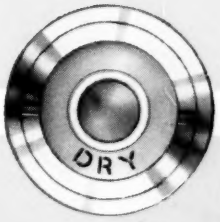

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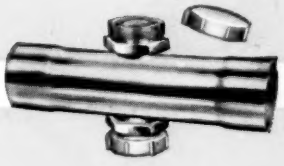

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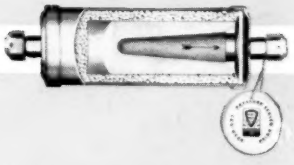

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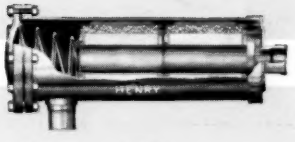

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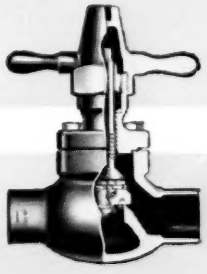

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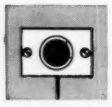
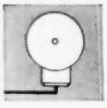
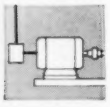


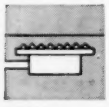
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



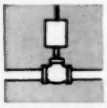
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

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FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

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